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MATERNAL HEALTH AND CHILD BEHAVIORS AS RISK FACTORS FOR CHILD
INJURY

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science
at Virginia Commonwealth University

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Abstract

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Evidence suggests that child behavior, parent mental health, parent supervision, and home environment conditions impact a child's risk of injury. Vulnerable families are at greater risk for the occurrence of child behavior problems, poor health, decreased supervision, and hazardous home conditions. Consistent with a model that proposes that parent, child, and environment factors interact within the lens of sociocultural factors to predict injury, the current study aimed to test a statistical model with maternal physical health and child externalizing behaviors as predictors of child injury, and home hazards and supervision as mediators of these relations. Analyses were conducted using a nationally representative sample of 3,288 vulnerable mother-child dyads. Results showed significant relations between parent physical health and child injury, and child aggression and child injury, though home hazards and supervision did not mediate either of these relations. Further research should continue to examine the mechanisms of action in the parent health- child injury relation so that injury prevention interventions can be developed.

Maternal Health and Child Behavior as Risk Factors for Child Injury

Unintentional injuries are the leading cause of death and disability during childhood (Morrongiello, 2005). On average, 12,175 children die every year from injury-related causes (Borse, Gilchrist, Dellinger, Rudd, Ballesteros & Sleet, 2008) and approximately ¼ of children in the U.S. are medically treated for injuries every year. Interestingly, injury type and location in children varies by developmental stage (Rivara, 1995; Scheidt, Harel, Trumble, Jones, Overpeck, & Bijur, 1995; Shannon, Brashaw, Lewis & Feldman, 1992). For example, toddlers and preschoolers are most frequently injured in and around the home, most of these injuries being falls, burns and poisonings. School aged children are most frequently injured away from home and outside while playing. Because on average, 12,175 children die every year from child injury, it is imperative that research examine the risk factors associated with childhood injury.

Multiple risk factors have been implicated in childhood injury including child behavior problems, parenting behaviors and family demographics (Speltz, Gonzales, Sulzbacher & Quan, 1990; Schwebel & Brezaussek, 2008). Using a large sample representative of births in the 77 United States cities with populations over 200,000 (Fragile Families, 2011), and an overrepresentation of disadvantaged and vulnerable families, the current study aims to further examine these risk factors. Specifically, the current study examines the impacts of maternal health, child behavior problems, maternal supervision and home environment hazards on whether or not a child is injured at age three in a sample of 3,288 children gathered for the Fragile Families' and Wellbeing Study. The Fragile Families and Wellbeing Study seeks to better describe the characteristics of "fragile families." According to this study, Fragile Families are those who have a non-marital birth, as these families are at higher risk for a number of

negative outcomes including behavior problems, health problems, more hazardous environments, poorer parental supervision, and higher rates of injury.

The present study first reviews existing literature on child behavior as it relates to child injury. Much of this literature implicates overactive, hyperactive and under-controlled behavior in increased risk of child injury (e.g., Farmer & Peterson, 1995; DiScala, Lescohier, Barthel, & Li, 1998; Spinks, Nagle, Macpherson, Bain, & McClure, 2008 & Schwebel, Speltz, Jones, & Bardina, 2002). This paper also reviews literature on parent health as it relates to child injury. A great deal of existing research demonstrates that children are at greater risk for injury than their peers when their parents have symptoms of psychological disorder (e.g., Schwebel, Speltz, Jones & Bardina, 2002; Russell, 1998; Schwebel & Brezaussek, 2008). However, very few studies (Russell, 1998 & Sibert, 1975), and no recent studies, have examined child injury as it pertains to parent physical health. Additionally, existing research on parent supervision, as it pertains to child injury risk, is reviewed. A great deal of existing literature reveals that when parents are more proximal to their children their children are less likely to be injured (e.g., Plumert, 1995; Plumert & Schwebel, 1997; Schwebel & Bounds, 2003). Existing literature also concludes that when fewer preventative precautions are taken by parents in a child's environment that child is at increased risk of injury.

Because child injury in children from vulnerable families is a critical problem, and therefore one that is very important to understand, literature related to three areas is reviewed in this paper. First, the existing literature related to injury in vulnerable children and families is reviewed. Second, the framework from which to understand the interaction between child injury risk factors is reviewed. Finally, each variable in the proposed model predicting child injury is reviewed in detail.

Why Study Injury in Fragile Families?

The Fragile Families data set provides the sample for the present study. These data were collected longitudinally through collaboration between Princeton and Columbia Universities (“Fragile Families,” 2011). “Fragile Families” refers to “unmarried parents and their children as ‘fragile families’ to underscore that they are families, and that they are at greater risk of breaking up and living in poverty than more traditional families (Fragile Families, 2011).” Lone-parenting and living in poverty increase a child’s chance of negative outcomes including injury (e.g., Bijur, Stewart-Brown & Butler, 1986; Crandall, Sridhara & Schermer, 2010; Rivara & Barberm, 1985). For this reason, the current study examines the factors associated with injury in the Fragile Families sample.

Fragile families include those families that are more subject to poverty, which is important because the socioeconomic status of a child’s family is related to injury risk (Rivara & Barberm, 1985). Results of a national survey revealed that children who were in lower income strata were more likely to experience injury (Crandall, Sridhara & Schermer, 2010). An earlier study conducted in Great Britain, surveyed the parents of 98% of the children born in one week in April 1970. Findings revealed that children in lower socioeconomic status families had higher rates of injury/accidents because they had greater access to unsafe household products, and lived in generally more crowded and poorer housing situations (Bijur, Stewart-Brown & Butler, 1986). Bijur and his colleagues further posited that these socioeconomic factors are more significant risk factors for injury than aggressive and overactive child behavior. A recent study conducted by Sengoelge, Hasselberg, Ormandy and Laflamme (2013) cross-sectionally examined the occurrence of injury in 26 European countries and found that child injury mortality rates increased with decreased income and increased housing strain. Another recent study examined

emergency department visits in the UK and found that emergency department attendance for most kinds of injuries was associated with socioeconomic deprivation (Hughes, McHale, Wyke, Lowey & Bellis, 2013). Though most studies have found a strong connection between poverty and child injury, it is important to note that not all research has supported the relation between child injury and family socioeconomic status. McCormick, Shapiro and Starfield (1981) found no correlations between child injury and socioeconomic status, illness in infancy, or low birth weight.

Low socioeconomic status and minority race are often concomitant and fragile families also tend to be of minority race. No study that the author could identify has examined how child race and socioeconomic status may share variance when accounting for child injury, though research in other areas has identified covariance between these variables as they relate more generally to health disparities (House & Williams, 2000). Similarly, according to the National Center for Education Statistics (2002), “the overall percentages of families with children in poverty were higher for Blacks, American Indians/Alaska Natives, Hispanics, and Native Hawaiians or Other Pacific Islanders (ranging between 20 and 30 percent) than for Whites and Asians (both 10 percent).” Research has shown that 71% of children who have been injured multiple times are of minority race backgrounds (Crandall, Sridharan & Schermer, 2010). African American race has been implicated as an especially strong predictor of injury by age three. This same study, conducted by Crandall et al., posited that caregiver characteristics are secondary to neighborhood and community attributes in predicting childhood injury risk. Similarly, Fingerhut and Kleinman (1989) studied a specific type of injury: firearm mortality. Their results showed that firearms less frequently killed white male children than black male children.

In addition to socioeconomic status and race, size of family has also been linked to injury risk in children. For example, Bradbury et al. (1999) used measures of family functioning and health care utilization to predict child injury in the following year. They found that school-age children in large families may be at increased risk of injury because they are more likely to attempt to assert themselves by behaving in a manner beyond their ability in order to “keep up” with older siblings. Also, Bradbury and his colleagues speculate that it may be that parental supervision is less consistent in larger families. For example, larger families are more likely to have more sibling supervision, which increases the risk of injury (Morrongiello, Schell & Keleher, 2013). Interestingly, explicit instruction to supervise a younger sibling is associated with less younger sibling engagement in contrived hazards in a research situation (Morrongiello & Schell, 2013).

According to existing literature on the topic of child injury, demographic factors such as the size of the family a child belongs to, the child’s race and the child’s gender can affect a child’s risk of injury. As low socioeconomic status, minority race and family size are all associated with increased risk of injury and are also characteristics of fragile families, the Fragile Families sample is an important one to employ in the present study’s examination of child injury risk. Only two studies have looked at child injury as an outcome with the Fragile Families data, thus further study in this area is warranted.

Prior Research with the Fragile Families and Child Wellbeing Data Set

The current study uses data collected as part of the Fragile Families and Child Wellbeing study. Very little research has been completed with this data set examining child injury risk factors; however, two studies by Marie Crandall, Lakshmi Sridharan and their colleagues (Crandal, Sridharan & Schermer, 2010; Sridharan & Crandal, 2011) examined injury and health

among toddlers (three year olds) and children (five year olds) in vulnerable families. These studies examined families living in violent neighborhoods, defined as areas with gang presence, near neighbors who were unlikely to intervene in unlawful situations, who did not participate in childcare, whose parents did not participate in civic groups and who had public health insurance coverage. Unemployment, low income, use of alcohol and drugs, and presence of family violence were also characteristics of families examined in this study. In both of these studies, the outcome of injury was examined dichotomously as having occurred in the past year or not having occurred in the past year.

In the study of five year olds (Sridharan & Crandal, 2011), neighborhood and environmental characteristics (gang presence, neighborhood violence, likelihood of neighbors intervening in unlawful or uncivil child behaviors, childcare program participation, maternal participation in civic groups and type of health insurance coverage) were examined as possible predictors of child injury. Results showed that injuries in year five were associated with male gender and lower income status. In their similar study of three year olds, income, employment status, use of alcohol or illicit drugs by the mother or father, history of violence in the family and use of physical discipline were assessed for their relation to child injury, child development, and perception of overall child health. The study of three year olds (Sridharan et al., 2010) revealed that injuries were most common among African American children, children of young mothers, children of mothers with less than a high school education, and children with a previous injury. These results demonstrate increased risk of injury in socioeconomically disadvantaged children. Results of Sridharan and Crandall's 2010 and 2011 studies also reveal that child age and caregiver characteristics seem to decrease in the degree to which they accounted for injury

effects, whereas environmental characteristics seemed to increase their importance in accounting for the injury effects.

Turney and colleagues (2011) examined similar variables using the Fragile Families and Child Wellbeing Study. Turney (2011) examined predictors of child health. Child health was defined as a combination of parental report of general child health and an asthma attack, hay fever or respiratory allergies, eczema or skin allergies, dental visits, emergency room visits, and doctor visits due to injury, in the past year. Predictors included maternal depression, socioeconomic status, family change, parental relationships, family structure transitions and parent health and health behaviors, physical health problems (physical health problems that limit work, smoked in the last month, substance abuse problems, and number of days playing outside with the child), the mother's relationship with the child's father, and demographics. Results indicated that chronic maternal depression increases five year olds' risk of injury. Also, results showed that mothers with chronic depression are more likely to have children with physical health conditions (e.g. asthma, allergies), but not necessarily more injuries. Socioeconomic status, family instability, and maternal health and health behaviors, were determined to be mechanisms through which maternal depression increases a child's risk of injury.

Studies conducted by Crandal, Sridharan & Schermer (2010), Sridharan & Crandall (2011) and Turney (2012) are the only studies to have identified predictors of child injury with the Fragile Families data set. Taken together they indicate that a number of factors including demographic factors, neighborhood factors, and parent factors predict a vulnerable child's risk of injury. While these previous studies have examined neighborhood environment characteristics as predictors of child injury and parent health factors as predictors of child injury within the Fragile Families sample, no study has yet defined the relations between parent physical health,

child externalizing behavior, parent supervision, home environment hazards, and child demographic characteristics, and their combined role in the occurrence of child injury. A model proposed by Barbara Morrongiello (2005) provides the framework for the examination of the interactions between these variables.

Theoretical Basis

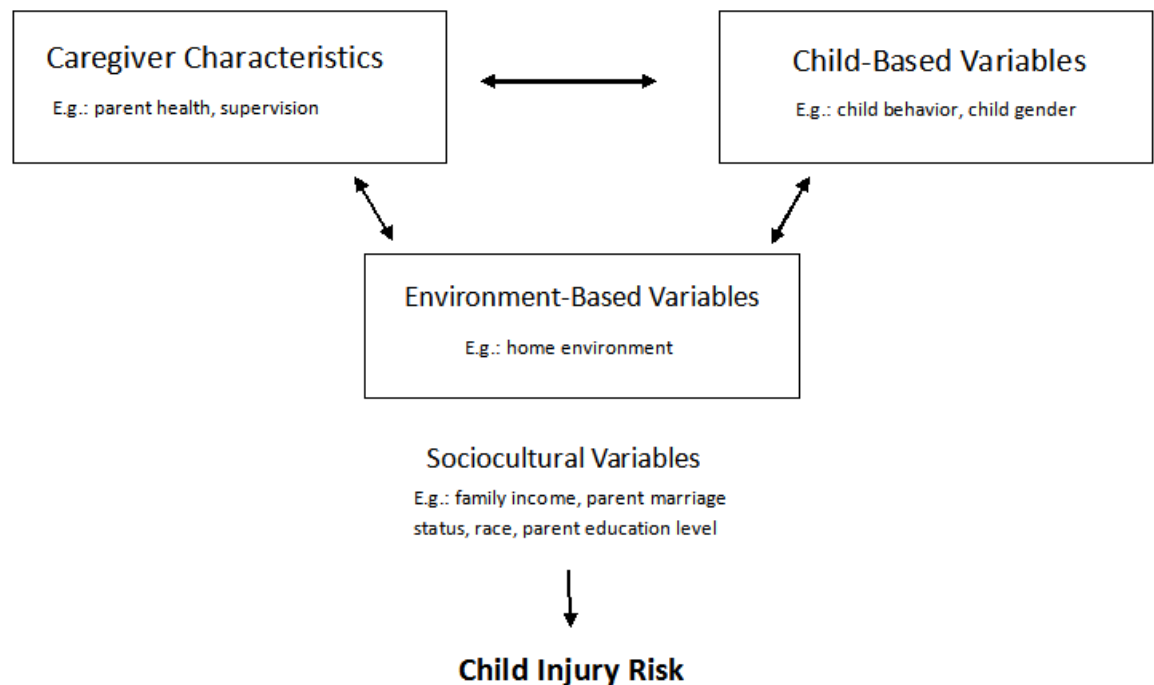


Figure 1. Theoretical model proposed by Morrongiello (2005)

The current study examines its aims through the lens of a conceptual model proposed by Barbara Morrongiello (2005). This model proposes that caregiver and child variables (attitudes, behaviors, cognitions, distractibility, expectations for self and others, feelings, goals, hazard awareness and personality) interact (Figure 1). These caregiver and child variables also independently interact with the child's environment. Parent, child and environment variables interact within the context of sociocultural factors to determine a child's risk of injury. In this way, it is expected that mother variables such as maternal health (body mass index, self-rated

health, medications being taken, health issues interfering with work), and supervision (whether or not a parent keeps a child in view), child variables such as child behavior (as measured by the Child Behavior Problems survey) and environmental variables (whether or not the physical home environment is safe) will interact within the context of demographic, control variables (child gender, family size and family income) to determine a child's risk of injury within this study. The following is a review of the literature for each of these variables.

Child Characteristics and Injury Risk

Individual characteristics of children are often associated with child injury. For example, child injury risk varies according to child age and gender. Matheny (1987) examined existing literature and determined that there are age differences in injury type and location; specifically, in early childhood, injuries are generally attributed to parent, home, and environment characteristics whereas when children enter school, their injuries tend to be more associated with their psychological characteristics.

Boys and girls differ in locations of injury as boys are most frequently injured in playrooms and because of misbehavior whereas girls are most frequently injured in non-play areas of their homes while playing. Boys more frequently sustain head and neck injuries and more serious injuries than girls (Baker, O'Neill & Ginsburg, 1992; CICH, 1994; Rivara, Bergman, LoGerfo & Weiss, 1982). Through analysis of written diary entries and telephone interviews about injury events, mothers prospectively tracked child injuries for 12 weeks. This study by Morrongiello and her colleagues revealed that girls react more to injuries than boys (2004). Some studies have suggested that frequency of injury differences, as a function of gender, can be attributed at least in part to a decreased allowance for female independence and freedom (e.g., Basow, 1986; Block, 1983; Cowan & Avants, 1988; Morrongiello & Dawber,

1999, 2000; Saegert & Hart 1976a; Saegert & Hart, 1976b) and that female children may be less frequently injured because of parents' increased supervision of female children so as to avoid injuries and the intense reactions that often accompany them (Morrongiello & Dawber, 1999, 2000).

Interestingly, Morrongiello et al. (2004a/b) found that “mothers find it difficult to elaborate the details of how they supervise, and strategies vary tremendously depending on child, parent and environmental factors (p.427).” This finding elaborates the importance of a multi-causal approach to examining risk factors for child injury (Bradbury, Janicke, Riley & Finney, 1999; Rivara, 1995; Scheidt et al., 1995; Shannon, Brashaw, Lewis & Feldman, 1992).

In sum, a wide array of individual characteristics could play into a child's risk of injury. Child age and child gender are two of the most prominent characteristics in existing literature. Children who are younger (prior to entrance in school) are more likely to be injured at home (Matheny, 1987) whereas children who are older (school-aged) are more likely to be injured outside of the home. Because in-home child injury is a larger problem in children prior to entrance in school, the current study utilizes a sample of three year olds collected as a wave of the Fragile Families and Wellbeing Study (“Fragile Families”, 2011) and examines supervision and environmental characteristics within the child's home. Child gender has also been identified as a variable strongly associated with the occurrence of injury in children. Males are more frequently and seriously injured than females (Baker, O'Neill & Ginsburg, 1992; CICH, 1994; Rivara, Bergman, LoGerfo & Weiss, 1982) though this relation is highly associated with cultural gender norms (Basow, 1986, Block, 1983; Cowan & Avants, 1988; Morrongiello & Dawber, 1999, 2000; Saegert & Hart 1976a; Saegert & Hart, 1976b). Because males are more frequently injured than females, the current study includes child gender as a control variable.

Child Behavior and Child Injury Risk

The present study also includes child behavior as a predictor of child injury. A number of studies have examined how a child's behavior can impact that child's risk of injury. While testing their Injury Behavior Checklist, Speltz and his colleagues (Speltz, Gonzales, Sulzbacher & Quan, 1990) found that children who engage in more risky behavior sustain more injuries than children who do not. Other studies have provided additional support for this finding and have added that children who score high on measures of sensation seeking are more frequently injured in their homes (Morrongiello, Ondejko & Littlejohn, 2004a & 2004b). Speltz and his colleagues' study additionally concluded that male children are more frequently injured than female children (Borse, Gilchrist, Dellinger, Rudd, Ballesteros & Sleet, 2008; Crandall, Sridharan & Schermer, 2010), and that a child's ability or inability to determine the risk associated with a behavior influences that child's risk of injury.

Other studies have determined that children with externalizing behavior disorders are more frequently injured. One externalizing disorder often examined for its relation to childhood injury is Attention Deficit Hyperactivity Disorder (ADHD). Multiple studies have concluded that children with ADHD are at increased risk of injury because of their hyperactivity, impulsivity, and inattention (DiScala et al., 1998; Farmer & Peterson, 1995; Lange, Buse, Bender, Siegert, Knopf & Roessner, 2014; Spinks et al., 2008). Some researchers attribute increased risk of injury in children with ADHD to decreased expectations of personal risk in hazard situations and decreased ability to determine preventative approaches to hazardous situations. Other researchers associate increased risk of injury with an inability to engage in "cause-and-effect" reasoning due to changes in neuropsychological functioning in children with ADHD (Schwebel, Speltz, Jones, Bardina, 2002). While these studies have demonstrated in

various ways and for various reasons that children with ADHD have increased rates of injury, some have argued that ADHD has only a modest (Davidson, Hughes & O'Connor, 1988; Schwebel, Speltz, Jones & Bardina, 2002) or no (Byrne, Bawden, Beattie & Dewolfe, 2003) relation to injury in children.

Researchers who find no differences in injury frequency between ADHD groups and control groups often explain that child injury risk is more accurately accounted for by different externalizing disorders: oppositional defiant disorder (ODD) and conduct disorder (CD; Davidson, 1987; Jacques & Finney, 1994; Rowe, Maughan & Goodman, 2004; Schwebel, Speltz, Jones & Bardina, 2002). These researchers posit that most often, comorbid diagnoses of ODD and CD with ADHD are responsible for the misconception that ADHD is responsible for increased risk of injury (Byrne et al., 2003). Findings, however, are inconsistent, as still other researchers have demonstrated that ODD plays only a modest role in accounting for injury risk (Schwebel, Hodgins and Sterling, 2006).

Taken together this literature suggests a great deal of disagreement over the role that externalizing disorders play in child injury. While some studies argue that children with ADHD are at increased risk for injury (DiScala et al., 1998; Farmer & Peterson, 1995; Schwebel, Speltz, Jones, Bardina, 2002; Spinks et al., 2008), many studies refute this, arguing that instead it is comorbidity with other diagnoses such as ODD and CD (Davidson, 1987; Jacques & Finney, 1994; Rowe, Maughan & Goodman, 2004; Schwebel, Speltz, Jones & Bardina, 2002), or even demographic variables (Spinks et al., 2008) that are responsible for increased risk of injury in children.

While a great deal of literature has focused on externalizing disorders as predictors of child injury, fewer studies have more generally examined externalizing behavior problems as

predictors of child injury. Findings vary with regard to the predictive nature of externalizing behaviors. Studies of child pedestrian injury have found that aggression, and externalizing child behaviors are not predictive of the occurrence of injury (Pless et al., 1989; Cristofell et al., 1996). Another study examined the role of child behavior in the relation between maternal depression and child injury (Phelan, Khoury, Atherton & Kahn, 2007). While externalizing behavior was not found to mediate the relation between maternal depression and child injury, children with more externalizing behavior problems were more frequently injured in this sample. Another study conducted by van Aken and colleagues (van Aken, Junger, Verhoeven, van Aken & Dekovic, 2007) used the Child Behavior Checklist (Achenbach, 2000) to determine the role of externalizing behavior in the occurrence of minor unintentional child injuries in toddlers. The results of this study showed that child externalizing behavior predicted the occurrence of minor injuries in toddlers beyond other predictors like socioeconomic status, time spent in daycare and family size. Karazsia and colleagues (Karazsia, Manfred, van Dulmen, 2010) also found that child externalizing behaviors were predictive of the occurrence of minor injuries in 812 children in a nationally representative sample.

Clearly there is a great deal of room for clarification of the relation between child injury and child behavior problems. As fewer studies have examined child externalizing behavior and no studies that the author could identify parsed this construct even further into aggressive and destructive externalizing behaviors, the present study examines the direct relations between destructive behavior and injury and aggressive behavior and injury using aggressive and destructive behavior measures modified from the Child Behavior Checklist (Achenbach, 2000).

Parent Health and Child Risk of Injury

An additional factor associated with increased risk of child injury is parent mental health (e.g., Speltz, Jones & Bardina, 2002). For example, one study found that 50% of children with repeat injuries had parents with serious psychiatric illness (Husband & Hinton, 1972). This same study found that psychopathology in one or both of a child's parents significantly increases the child's risk of unintentional injury. A specific psychological disorder, maternal depression, is another risk factor for child injury. Children of white mothers reporting depressive symptoms in a 1991 survey were found to have increased rates of repeat injury (Russell, 1998). Another study examined data from the National Institute of Child Health and Human Development Study of Early Child Care (Schwebel & Brezaussek, 2008). This study longitudinally surveyed mothers about their children's early care and development, and determined that in their study, the most salient factor associated with child injury was severe maternal depressive symptomology, even after accounting for demographics, child characteristics, and parenting-style factors; moderate or non-clinical levels of depression were not associated with increased rates of child injury. Another study examined the role of maternal depression, child characteristics, and child behavior in the prediction of child injury in a large nationally representative sample (Karazsia, et al., 2010). Among other findings, this study identified maternal depression as a significant predictor of the number of medically attended injuries of a child. While many studies have identified maternal depression as a risk factor for child injury, another study argued that depression is not necessarily a risk factor for injury, but good parent mental health is protective of injury in children. This study found that childhood injury was less likely for children of mothers who were emotionally stable and active than for other children (Matheny, 1987).

While many studies have implicated parent mental health as a risk factor for child injury, few studies have clearly implicated parent physical health as a risk factor for child injury.

Russell (1998) sampled mothers whose children were alive at the time of a 1991 survey of children born in 1988. He found that children with repeat injury episodes were more likely to have mothers with lower perceived levels of health and higher scores on a depression inventory, but called for additional research to determine the mechanism by which these relations operated. Interestingly, research has also identified children of parents with physical health problems as having increased risk of injury because they have greater access to medication (their parents have more of them and are less attentive due to preoccupation with their own physical ailments; Sibert, 1975). This set of circumstances leads to a higher rate of accidental poisoning in children with physically unhealthy parents.

Parent mental health has been consistently associated with increased risk of child injury. Most studies looking to explain this association have identified decreased parental engagement with their child's environment (Leiferman, 2002; McLennan & Kotelchuch, 2000; Mulvaney & Kendrick, 2006) and general disengagement in their child's life (Lovejoy et al., 2000) as explanation for this relation. With very few studies having examined parent physical health as it relates to child injury risk, and the high frequency of deaths in children due to injury (Morrongiello, 2005) there exists a definitive need for further research to determine whether a parent's physical health is predictive of a child's risk of injury. If it can be determined that poor parent physical health is a predictor of injury in children, then intervention may be able decrease the occurrence of injury more effectively by targeting children whose parents are in poorer physical health.

Parental physical health is an especially important consideration for vulnerable families as individuals from low income and minority groups are more likely to have health problems (Krieger, Williams & Moss, 1997) including heart disease (Bosma et al., 2005; Bibbins-

Domingo et al., 2009), stroke (Kuper, Adami, Theorell & Weiderpass, 2007), breast cancer over age 40 (Anderson, Rosenberg, Menashe, Mitani & Pfeiffer, 2008) and metabolic syndrome (Prescott, Godtfredsen, Osler, Schnohr & Barefoot, 2007) all of which ultimately lead to higher rates of mortality (Alter et al., 2006). As there is a higher rate of physical health problems in adults in vulnerable families, the impact this has on vulnerable children, especially their risk of injury, is an important area of study.

Parent Supervision

Direct predictor. In addition to child behavior difficulties and parent health problems, parent behavior, specifically parental supervision, has also been associated with child injury (Davidson, 1987; Morrongiello, Corbett, McCourt & Johnston, 2006; Rowe, Maughan & Goodman, 2004; Schwebel, Speltz, Jones & Bardina, 2002). Garbarino (1988) speculates that inadequate supervision may be the leading cause of child injury. While a great deal of the literature examining this problem focuses on the role of maternal supervision, little research has looked at the role of paternal supervision in the occurrence of injury, but one study compared the roles of maternal and paternal supervision in the prediction of and severity of child injury (Damashek & Kuhn, 2013). The authors found that close supervision by mothers and fathers both decreased the occurrence of injury; however, when children were supervised by their fathers alone children were more likely to engage in more activity and were found to be at greater risk for injury.

Interestingly, multiple studies have concluded that parents realize the importance of varying the amount and type of supervision they provide for their children, depending on their child's environment and developmental level (Fagot, Krosberg & MaGregor, 1985; Garling & Garling, 1993a, 1993b; Peterson, Ewingman & Kivlahan, 1993). Despite this, it has not been

demonstrated that parents actually make these types of supervision adjustments (Glik, Kronenfeld, & Jackson, 1991; Glik, Greaves, Kronenfeld, & Jackson, 1993; Rosen & Peterson, 1990). One study by Morrongiello and colleagues (2004b) examined how parental risk management strategies differed depending on the location of a child's injury. Using a prospective design, researchers collected maternal reports of child injuries via telephone interview and diary for 12 months. Findings revealed that supervision was effectively and most frequently employed as a prevention strategy when children were in high-risk areas like bathrooms and kitchens. Interestingly, mothers used environmental prevention strategies in rooms designated to play, and parent-based (instructional) approaches to prevention in living-rooms, as they were unwilling to strip these rooms of interesting décor in exchange for environmental prevention strategies. This same study revealed that supervision did not necessarily guarantee injury prevention and that only constant monitoring and direct supervision would truly reduce injury.

A study by Russell (1998) examined parent supervision strategies in a laboratory environment. Children were given six blocks of four tasks to complete, set to one of five difficulty levels (well within, below, just within, just beyond, and well beyond the child's ability). Findings suggest that children and parents both overestimated the children's abilities. When parents were closer in proximity to their children, especially their temperamental children, both parents and children were better able to estimate the children's abilities. Other studies have corroborated these findings (Garling & Valsiner, 1985; Plumert, 1995, Plumert & Schwebel, 1997; Schwebel & Bounds, 2003; Valsiner & Lightfoot, 1987). Russell concluded that in order to prevent injury, parents need to remain near their children so that they can better intervene to *prevent* risk taking behaviors and subsequent injuries.

Indirect predictor. While many studies have examined the direct relation between supervision and child injury, many other studies have looked at supervision as a mediator or moderator of the relation between child behavior and child injury. Morrongiello, Ondejko and Littlejohn (2004a & 2004b) determined that parent protectiveness and beliefs about supervision are relevant to child risk of injury. One study demonstrated this link. In a prospective study, mothers provided detailed reports of in-home child injuries and caregiver supervision at the time of injury (Morrongiello, Ondejko & Littlejohn, 2004a & 2004b). Results showed that children who engaged in greater risk-taking behavior limited their injuries with increased parental supervision. Children who demonstrated less risky behavior were at decreased risk when intermittently supervised.

Many studies have additionally demonstrated that while under-controlled child behavior increases child injury risk, parent supervision can moderate the intensity of this risk (Davidson, 1987; Rowe, Maughan & Goodman, 2004; Schwebel, Speltz, Jones & Bardina, 2002). Specifically, children with behavior problems and low levels of parental supervision may be at increased risk for unintentional injury. For example one study (Schwebel, Brezaussek, Ramey, & Ramey, 2004) demonstrated that children who are hyperactive, impulsive and oppositional have decreased risk of injury with parental supervision. Other studies have demonstrated results that mothers of children with behavior problems have more external loci of control than mothers of children without behavior problems (Damashek, Williams, Sher, Peterson, Lewis, Scweinle, 2005; Morton, 1997). In light of knowledge that children with behavior problems are more frequently injured, it could be concluded that children with behavior problems are also more likely to be repeatedly injured as their parents are less likely to attempt to change their children's environments due to their external loci of control.

One study considered parent health factors in conjunction with child behavior and parent supervision. Schwebel, Hodgins, and Sterling (2006) supported Garbarino's speculation that supervision is one of the most important predictors of child injury, and found that parental supervision may play the most critical role in explaining why children with behavior problems are at higher risk for injury. In their study, injury was most strongly predicted by mothers ignoring their children's behavioral risk-taking. They hypothesized that this may have been because children with behavior disorders may have parents who possess more dysfunctional characteristics (e.g., depression, hostility, stress, low self-esteem, and marital dissatisfaction) and therefore supervise less frequently, or less effectively, but this was a proposed explanation that requires further research.

In summary, the extent to which a parent supervises, and the quality of that supervision can greatly impact a child's risk of injury. Children who are inadequately supervised are at increased risk of injury. Supervision is not only greatly dependent on parents' understanding their children's abilities, but also on parents' other values, like the aesthetics of their environments (Morrongiello et al., 2004b). A parent who knows that his/her child is at high risk for injury because of a behavior disorder can intervene at multiple levels including the child's environment, but most effectively at the point in time when they see the child behaving in a risky manner (Russell, 1995). In this sense, injury is most likely prevented when parents are in close proximity to their children. In addition to the literature that has found supervision as a direct predictor of child injury, a number of studies have also identified it as an indirect predictor of child injury.

Because children in the Fragile Families study generally belong to single parent, low income, and otherwise vulnerable families (Fragile Families, 2011), it is likely that these children

are less supervised as their parents are likely occupied by providing necessities for their families. Because of this, it is very important that the present study consider the impact of supervision on child injury risk in a vulnerable population.

Child Environment

Direct predictor. The Fragile Families data consists mainly of families with unmarried parents, living in poverty. The literature for these families shows that they are likely to have high rates of environmental hazards like residential crowding, poor quality housing (e.g., dilapidated structure, dark space, allergens), and poor neighborhood quality (i.e., noise, pollution, traffic, abandoned lots, violence; Evans & Kantrowitz, 2002). As fragile families are especially prone to environmental risks, it is important to examine the role that environmental conditions play in the occurrence of child injury within this sample.

Environmental hazards and housing conditions have been linked to increased risk of child injury (e.g., Myer, Roelofs, Bluestone, 1963; Spiegel, Lindaman, 1977; Wilner, Walkley, Pinkerton, & Tayback, 1962). One strategy used by many parents to decrease child injury is environmental prevention (modifying the child's environment to prevent injury) (Morrongiello, 2004b). This strategy is often used in conjunction with other strategies like increased supervision or rules teaching, but can also be used exclusively. Rules teaching is the preventative measure that parents take when they explain to their child what they should and should not do in risky situations. It is intended to encourage children to internalize information after hearing it repeatedly. While there is a dearth of existing literature examining the impact of instructional strategies on injury prevention, researchers have recently begun to examine instruction strategies more specifically. For example, Morrongiello, Widdifield, Munroe and Zdzieborski (2014) found that parents use instructional strategies more for older children (age 3-

3.5 years) than younger children (age 2-2.5 years) however they often instruct children that they can engage in hazardous behaviors under certain conditions (e.g., when a parent is present).

These situational instructions may actually lead to an increase in the rate of injury as children are unable to comprehend and practice the more complex rules. This may be one reason for which environmental prevention strategies are more often researched and practiced than instructional strategies.

Environmental prevention has been shown to significantly reduce child injury risk in past research. Environmental prevention occurs when caregivers make changes to the child's environment, usually their home, in order to eliminate risky environment characteristics (e.g., putting safety plugs in outlets, padding corners of tables, locking cupboards containing chemicals, and installing gates at the tops of stairs). Prior research has also shown that environmental approaches to injury prevention are most effective with young children as they are newly mobile and exploring their environment more than children at other ages (Rowntree, 1950).

While environmental approaches to injury prevention have proven effective, parents do not use many of the safety devices that are available to them, even when they are given to the parent free of charge (Colver, Hutchinson & Judson, 1982; Dershewitz & Williamson, 1977; Gallagher, Hunger & Guyer, 1985; Greensher, 1984). A number of factors may motivate or inhibit use of environmental prevention strategies including prior child injuries (Russell & Champion, 1996), parent beliefs about child developmental level, past success with prevention interventions, the extent of inconvenience associated with the prevention strategy, social influence, child age, child gender and perceived risk of environmental hazards (Damashek,

Borduin & Rois, 2013; Gilk Kronenfeld & Jackson, 1991; Greaves, Gilk, Kronenfeld & Jackson, 1994; Peterson, Farmer & Kashani, 1990; Wortel, de Geus & Kok, 1995).

Indirect predictor. Studies have suggested that children with depressed mothers are at increased risk of injury because depressed parents have decreased engagement in their children's environments and practice fewer preventative strategies (Leiferman, 2002; McLennan & Kotelchuck, 2000; Mulvaney & Kendrick, 2006). A study by McLennan and Kotelchuck (2000) examined depressed mothers' environmental strategies for preventing child injury and found that mothers who reported high levels of depressive symptomology also reported significantly poorer prevention practices for car seat use, covering plugs, and having ipecac in the home. This study indicates that depressed mothers intervene less to prevent injuries by modifying the child's environment than other mothers. Further evidence of this decrease in maternal intervention was found in a meta-analysis of literature on parenting behaviors of depressed mothers (Lovejoy, Graczyk, O'Hare & Neuman, 2000). This study revealed an association between depression and negative maternal behavior as well as disengagement from the child. This effect was even stronger for child-mother dyads that came from disadvantaged backgrounds. A recent study conducted by Phelan and colleagues (Phelan, Morrongiello, Khoury, Xu, Liddy & Lanphear, 2013) gathered maternal self-reports of their supervision practices at multiple time points and found that mothers' supervision styles change during the first 36 months of their child's life and that these changes are associated with maternal depression. This means that mothers who were depressed supervised differently than those parents who were not depressed.

Fragile families face an especially large number of barriers to environmental prevention strategy use. Demographic variables like parent education and income, as well as housing quality are associated with the likelihood of parental environmental intervention (Gielen, Wilson,

Faen, Wissow & Harvilchuck, 1995; Ueland & Kraft, 1996). Similarly, studies have found that living conditions can prevent parents from implementing safety equipment. As many fragile families do not live in homes that they own, and which they can modify, they are prevented from engaging in many environment-based injury prevention strategies (Mull, Agran, Winn, & Anderson, 2001; Olsen, Bottorff, Raina & Frankish, 2008). Fragile families also face the barrier of the additional cost required to use safety equipment in their homes (Mull et al., 2001; Brannan, 1992; Bennet, 2001; Roberts, Curtis, Liabo, Rowland, DiGuseppi & Roberts, 2004; Olsen et al., 2008). Equipment like smoke alarms, outlet plugs, and cupboard locks cost money that many vulnerable families cannot spare. Young, poorly educated mothers have also been found to have a difficult time identifying their children's developmental abilities and often assume that their children are not at risk for injury because they are too young for that risk. Subsequently, they choose to delay use of environmental prevention strategies (Mull et al., 2001, Bennet, 2001, Hendrickson, 2008; Gibbs et al., 2005). Along these lines, a study by Mulvaney, Watson, Smith, Coupland and Kendrick surveyed parents in the United Kingdom and found that minority ethnic families were more likely to unsafely store cleaning products when compared to white families.

Existing literature thusly indicates that the characteristics of a child's environment can affect that child's risk of injury and this is especially the case for fragile families. Because there is evidence that a child's environment can impact his/her risk of injury, and because there is evidence that parents play a role in the extent of environmental hazards present in a child's home, the current study includes child home environment hazards as a mediator variable in the model tested here.

Summary, Aims and Hypotheses

Taken together this literature suggests relations among family, parent, home environment, parental supervision and child behavior variables, and child injury. The current study aims to clarify the ways in which child behavior, parent supervision, home environment hazards and maternal health interact to predict child injury. Clarification of these interactions will provide further clarity as to the causes of child injury in vulnerable families, and therefore, a point of entrance for subsequent injury prevention interventions with this population. The current study examines these aims through the lens of a conceptual model proposed by Barbara Morrongiello (2005). This model suggests that caregiver (e.g., maternal health, supervision) and child variables (e.g., gender, externalizing behaviors) interact (Figure 1). These caregiver and child variables also independently interact with the child's environment (e.g., home environment hazards). Parent, child and environment variables interact within the context of sociocultural factors (e.g., income, family size) to determine a child's risk of injury. In this way, it is expected that mother variables such as maternal health (body mass index, self-rated health, medications being taken, health issues interfering with work), and supervision (whether or not a parent keeps a child in view), child variables such as child behavior (as measured by the Child Behavior Problems survey) and environmental variables (whether or not the physical home environment contains hazards) will interact within the context of demographic, control variables (child gender, race and family income) to determine a child's risk of injury within this study.

Aim 1. There is a great deal of debate over the impact of child behavior problems on child injury. Prior research has shown that children who are overactive, hyperactive or under-controlled are at greater risk for injury (e.g., DiScala et al., 1998; Farmer & Peterson, 1995; Spinks et al., 2008). While this finding has been consistently supported in the literature, other studies have argued that this is not the case (Byrne et al., 2003; Schwebel, Hodgins and Sterling,

2006). Child externalizing behavior has been clearly identified as a predictor of child injury; however research has mostly examined child externalizing behavior disorders, and not non-disordered externalizing behavior, as predictors of child injury. Similarly, the research has not deconstructed the subtypes of externalizing behaviors as predictors of child injury. Because of the general lack of continuity in findings with regard to this problem, and a lack of research examining the role of the subtypes of externalizing behavior in the occurrence of injury, the current study aimed to identify whether aggressive and/or destructive child behavior are associated with increased child injury risk in the current sample. Because of this, the current study examines non-disordered externalizing behavior (aggressive and destructive) as predictors of child injury. It was hypothesized that children with more externalizing behavior problems have more injuries.

Aim 2. Prior research has demonstrated that parent mental illness increases rates of child injury (e.g., Brown & Davidson, 1978; Russell, 1998; Schwebel, Speltz, Jones & Bardina, 2002), though prior research with the current data set has not corroborated this finding in children at child age three (Turney, 2011). Very limited research has examined the effect of parental physical illnesses and health on the rate of injury in children (Russell, 1998; Sibert, 1975). To address this gap in existing research, the current study aims to identify how maternal physical health relates to a child's risk of sustaining an injury in a 12 month period, using a large and nationally representative sample. It was hypothesized that children whose mothers have poorer health experience more injuries in a 12 month period than children whose mothers do not have physical health problems. Maternal health is a variable that was constructed from responses to items measuring body mass index (BMI), mother's self-rated health, self-report of health conditions that interfere with work, and self-report of mother's prescribed medications.

Aim 3. Parental supervision of children and home environment characteristics have also been directly associated with child injury risk (e.g., Myer, Roelofs, Blueston, 1963; Spiegel, Lindaman, 1977; Wilner, Walkley, Pinkerton, & Tayback, 1962). In addition, environmental involvement, but not parent supervision, has been identified as a mediator of the parent mental health-child injury relation (e.g., Leiferman, 2002; McLennan & Kotelchuck, 2000; Mulvaney & Kendrick, 2006). Interestingly, no study has examined the mediating role of supervision and environmental conditions on the relation between parent physical health and child injury. The current study aims to be the first to examine the mediating role of parent supervision and environmental hazards simultaneously in the parent physical health-child injury relationship. These are important relations to clarify as they may provide further information about the risk factors associated with child injury, thereby informing future preventative work with vulnerable families. It was hypothesized that supervision and home environment hazards independently mediate the relation between maternal health and child injury.

Aim 4. Because child behavior problems have often been associated with increased risk of child injury (e.g., DiScala et al., 1998; Farmer & Peterson, 1995; Schwebel et al., 2002; Spinks et al., 2008), and a number of studies have identified parent supervision as a mediator of this relation (e.g., Davidson, 1987; Rowe et al., 2004; Schwebel et al., 2002) but not home environmental conditions, the current study aims to identify if mothers' supervision and environmental hazards mediate the relation between child behavior and child injury. It was hypothesized that supervision mediates the relation between child behavior and child injury such that children with more behavior problems are injured at a less frequent rate when supervised and when in an environment without hazards, than children without behavior problems.

Methods

The data used in the current study were originally gathered as part of the “Fragile Families and Wellbeing Study” conducted through collaboration between Princeton and Columbia Universities (“Fragile Families,” 2011). Baseline data were collected in 75 hospital wards across the country at or around the time of a child’s birth. At that time, mothers were asked to identify the father of their infant and the fathers were then interviewed in person (at the hospital or in their home) or by phone. Core follow-ups (3, 5, 7 and 9 years) were conducted by phone using a Computer Assisted Telephone Instrument (CATI). If participants did not respond by phone, field interviewers were sent to the participants’ homes to conduct interviews. Additional non-core interviews were completed by field interviewers in-home. Ninety-eight percent of mothers and 95% of fathers who began the study at baseline completed their core three and five year follow-up surveys by phone. This is likely due to recruitment and follow-up procedures that included both phone and in-home follow-ups when participants were non-responsive (“Fragile Families”, 2011). Participants were given \$30 compensation for completing phone surveys and \$50 compensation for completing in-home interviews.

Participant Characteristics

The current study primarily examined the third wave of the “Fragile Families” study. This wave consists of three year post-birth follow-up interviews and is the focus of the present study because rates of injury are higher for children age three compared to older children (Borse, Gilchrist, Delliner, Rudd, Ballesteros & Sleet, 2008). Data were collected from parents of marital and non-marital births with an oversampling of non-marital births and single parents (Reichman, Teitler, Garfinkel & McLanahan, 2001). The original study collected data on child health and development from families at the child’s birth (at which point the families were recruited) and at follow-ups. Data were collected from 4,789 participants at baseline and 4,140 participants at 3

years. The Fragile Families study consists of multiple surveys. Only some participants agreed to participate in all of these surveys. Some refused the in-home survey as they were unwilling for researchers to visit their homes. The current study uses data collected from 3,288 participants at year three who completed both the core and in-home portions of the “Fragile Families” study.

Sampling Procedures

Participants were gathered from birthing hospitals across the United States (Reichman, Teitler, Garfinkel & McLanahan, 2001). Participating hospitals were stratified and randomly sampled from all United States cities with 200,000 or more people. These hospitals were stratified based on three factors: child support enforcement, welfare generosity, and labor market strength. Child support enforcement was defined as the rate at which paternity was established and the proportion of child support cases that resulted in an award of child support and payment. “Welfare generosity” was determined by the monthly welfare dollar amount paid to a family of four divided by the median monthly rent in the city in which that family lived. Labor market accounted for unemployment and job growth rates as well as population growth when job growth rates were not available. This stratification was performed to ensure that the sample used in the study was representative of the national population. Cities with populations of 200,000 or more were stratified into two groups: all extreme scores on the three factors or at least one moderate score on the three factors. The cities scoring only extreme on the factors were sorted into eight cells that represented the eight combinations of extreme scores. One city was randomly selected from each of the eight extreme stratified groups and eight more were randomly selected from the group of remaining cities that did not score extreme only. For example, Boston was randomly selected from a cell that categorized it as having high welfare generosity, a strong labor market

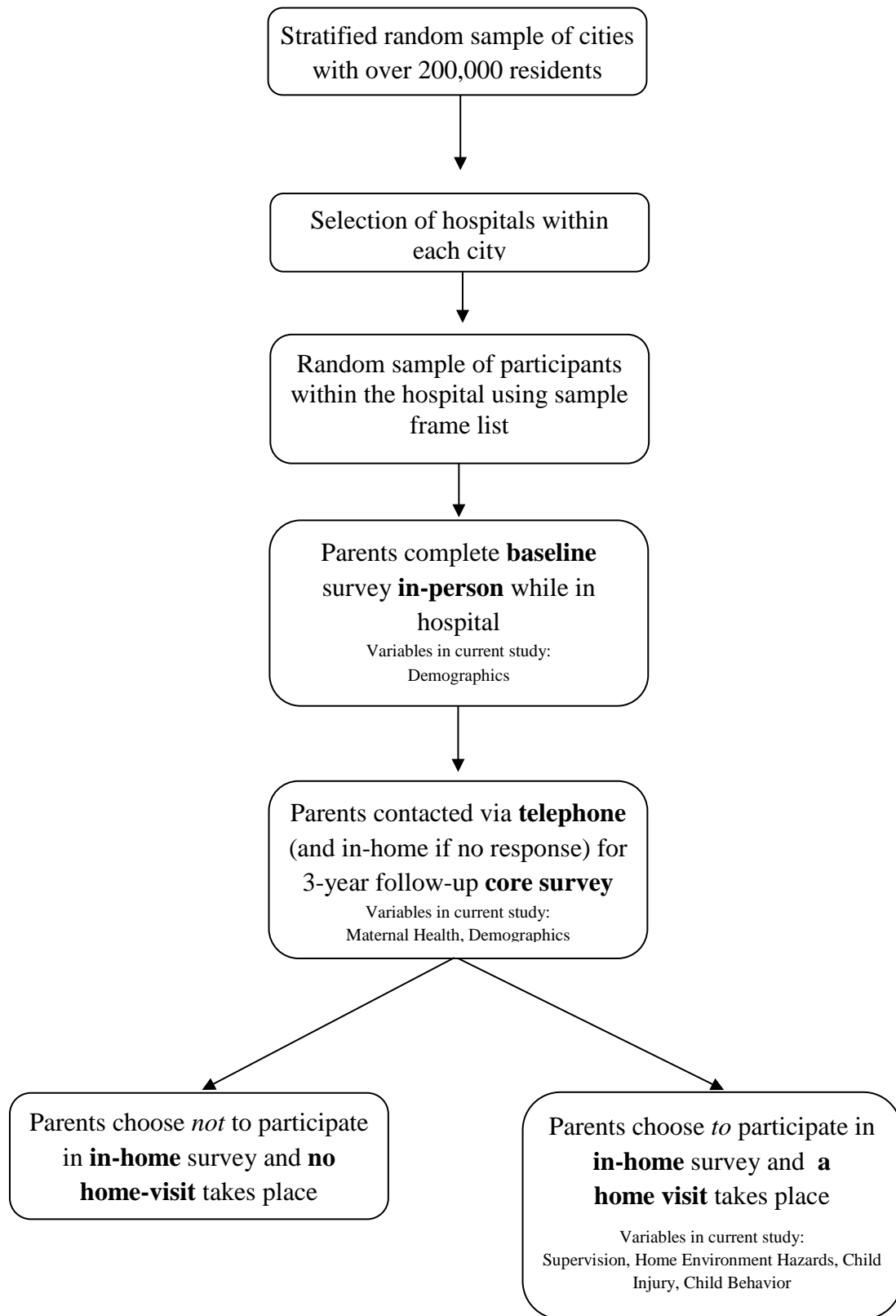


Figure 2. Sampling and data collection procedure.

and strict child support enforcement. Cities were randomly selected from each cell with a probability of being selected proportional to the population in that city (see Figure 3).

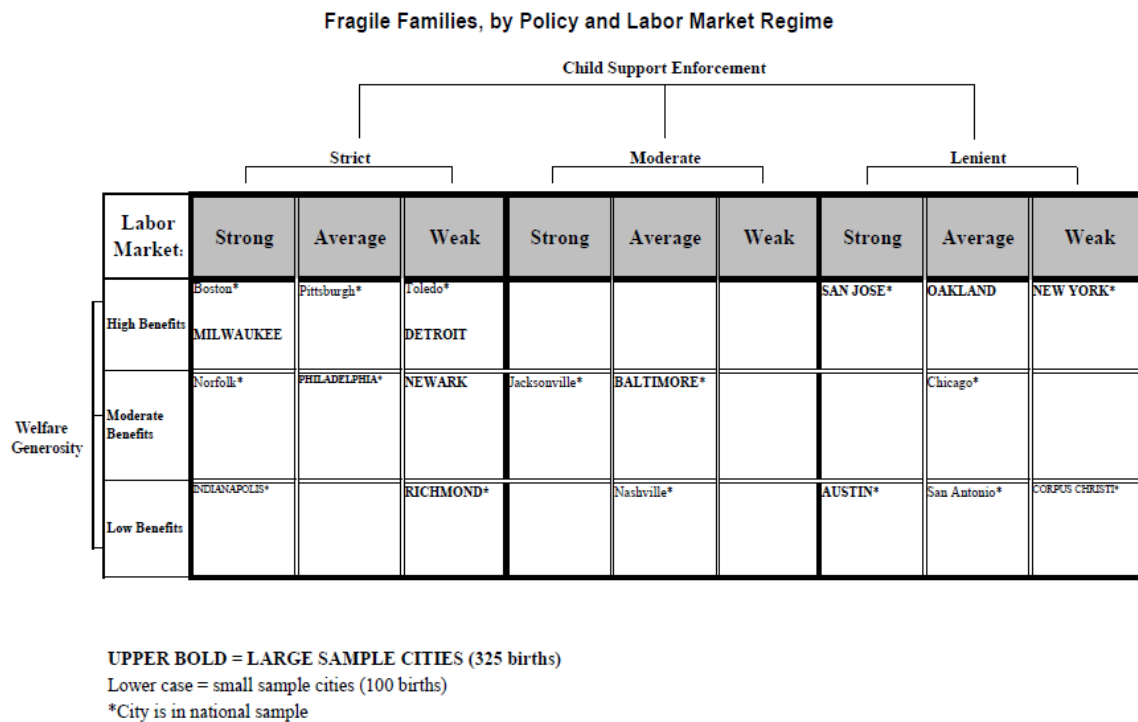


Figure 3. Fragile Families city sampling by Policy and Labor Market Regime (Reichman et al., 2011)

Within each of the randomly selected cities for participation, sampling hospitals were selected (Reichman, Teitler, Garfinkel & McLanahan, 2001). In five of the selected cities, all of the birthing hospitals in the city agreed to participate in recruiting and interviewing, and were therefore included. The remaining cities required random sampling of hospitals within the city limits that hosted over 1,000 non-marital births per year. Once these hospitals were selected, a sponsoring physician was recruited from each hospital to act as a liaison between the hospital and the researchers, and this individual obtained Institutional Review Board approval from within the hospital for completion of the study at that hospital.

Participants were randomly sampled from within the hospital (Reichman, Teitler, Garfinkel & McLanahan, 2001). Participants included married and unmarried parents who had recently given birth. These participants were chosen from a sample frame list of possible maternity beds on each unit. These beds were listed in numerical order and sample beds were chosen regardless of occupancy (“Fragile Families,” 2011). If no occupant was in the bed that was next on the sample list, the following bed on the list was used. Sampling continued until preset quotas were met. These preset quotas were based on the percentage of non-marital births in the city that occurred between the years of 1996 and 1997. If the actual values were found to be different while running the study, then the quota was adjusted accordingly.

Parents were excluded from participation if they planned on offering their child for adoption, if the father of the child was not living, if the parents did not speak English or Spanish, if the mother was too ill to be interviewed, if the child was too ill for the parent to take the time to be interviewed, or if the child died prior to recruitment (Reichman, Teitler, Garfinkel & McLanahan, 2001). Many participating hospitals also required recruitment to exclude parents who were younger than 18. In these cases, if either of the infant’s parents were younger than 18, the couple was excluded from participation.

The current study used data collected at the three year follow-up of the longitudinal “Fragile Families” study (Reichman, Teitler, Garfinkel & McLanahan, 2001). Baseline data were collected by the National Opinion Research Center at the University of Chicago and Mathematica Policy Research Inc. in Princeton, NJ. All subsequent data were collected by Mathematica Policy Research.

Measures

Measures of child injury, maternal health and child behavior were portions of larger surveys that included a number of other measures.

Child Injury Questionnaire. At the three year follow-up, child injury was assessed using a portion of the In-Home Longitudinal Survey (“Fragile Families,” 2011). This portion of the survey assessed number of pediatrician, emergency room and overnight hospital visits the participating child had in the past year. This questionnaire also assessed frequency, type and circumstances of child injuries in the past year. The current study uses an item responded to by the interviewer. This item asks if the parent reported any doctor or emergency room visits for accident or injury in the past year. To answer this item, interviewers reviewed the parent’s responses to items a8, a10, and a13. This item was used to determine whether or not a child has been injured in the past year. Child injury was included as a dichotomous variable (injured/not injured).

Maternal Health Questionnaire. Maternal health was assessed at the three year follow-up over the phone (or in-home if participants did not respond to telephone contact) using a portion of the Fragile Families “Core” survey (“Fragile Families”, 2011). This portion of the survey gathered data on maternal self-rated general health, medication use, limitations to work caused by health problems and height and weight over the previous 12 months. These items were used to construct the latent variable “poor maternal health.” Self-rated health has been used in other “Fragile Family” studies when examining the relation between quality of father health and incarceration (Curtis, 2010), quality of father health and marriage status (e.g. married vs. unmarried; Wilson & Brooks-Gunn, 2001) and quality of father health and living in public housing (Fertig & Reingold, 2007). Medication taking was used as a measure in the study of paternal health as it relates to incarceration rates (Curtis, 2010). A study of mothers’ health as it

relates to homelessness used the item asking about use of prescribed medication to assess maternal health (Park, Fertig & Metraux, 2011). These studies support the use of these measures as accurate assessments of the target construct.

Child Behavior Problems Questionnaire. At year three, child behavior was assessed using a portion of the In-Home Parent Questionnaire (“Fragile Families,” 2011). This portion of the In-Home Parent Questionnaire was based on three point likert-style items and scales from the Child Behavior Checklist (CBCL) 2-3 (Achenbach, 1988, 1992), the 2000 Achenbach Child Behavior Checklist and the Adaptive Social Behavior Inventory (ASBI; Hogan, Scott & Bauer, 1992). This questionnaire assessed behavior problems and prosocial behaviors in participating children (“Fragile Families,” 2011). It also identified the child’s need for mental health services and child social competence. Scales from the CBCL in this survey included the externalizing subscales (aggressive behavior and destructive behavior). Participants’ aggressive scores ($\alpha=.86$) and destructive scores ($\alpha=.64$) were used in the assessment of three-year-old child behavior in the present study. Time constraints in testing prevented the use of the entire Child Behavior Checklist and specific items were chosen for inclusion in the Fragile Families child behavior survey at the discretion of researchers, in order to allow for scoring similar to the full CBCL, while at the same time limiting the length of the survey.

Child Environment Hazards Measure. Child environment hazards were measured as part of the In-Home questionnaire (“Fragile Families,” 2011). Researchers in participant homes were asked to answer “yes” or “no” to “is environment inside home unsafe for children?” If the researcher replied “yes” they were asked to identify all observed hazardous conditions.

Parent Supervision Measure. At year three parent supervision of their child was measured by one item: “Parent kept child in visual range when child was not cared for by

someone else, looked often at (him/her) (often means enough to ensure safety of child and to keep some kind of interpersonal contact with (him/her; “Fragile Families”, 2011).” This item was completed by a researcher while he/she was in the participant’s home. The outcome of this item was dichotomous in that possible responses were limited to “in range” and “not in range”.

Design and Analyses

The current study used a path analysis approach to examine the associations within the proposed model (Figure 4) and to test the hypotheses. Path analysis is a type of Structural Equation Modeling that produces estimates of the extent of the hypothesized effects, and tests whether or not the model is represented within the data (Klem, 1995). These associations are represented by a series of regression analyses that can be most clearly described through graphic diagram models. The path model was tested using Mplus (Muthén & Muthén, 2012).

Mplus yields indices of how well the proposed model fits the sample data. The chi-square (χ^2) statistic is one of the fit statistics that Mplus yields, and evaluates the degree of difference between the study sample and the estimated model variance/covariance matrices (Wang & Wang, 2012). A non-significant χ^2 is desired as this demonstrates that there is no difference between the model and the sample. The Comparative Fit Index (CFI) compares the proposed model to the null model. The null model assumes that there is no covariance among the variables observed in the model. A CFI of 1 is indicative of the best possible fit of a model and a CFI of 0 is indicative of the poorest possible fit for the model. A model with a CFI of .90 or higher is generally considered an adequately fitting model. Root mean square error of approximation (RMSEA) measures the mean lack of fit per degree of freedom and RMSEA values of 0 are considered perfect fit, values less than .05 close fit, .05 to .08 fair fit, .08 to .10

mediocre fit, less than .10 poor fit. Hu and Bentler (1999) propose a cut-off of $\leq .06$ for good model fit.

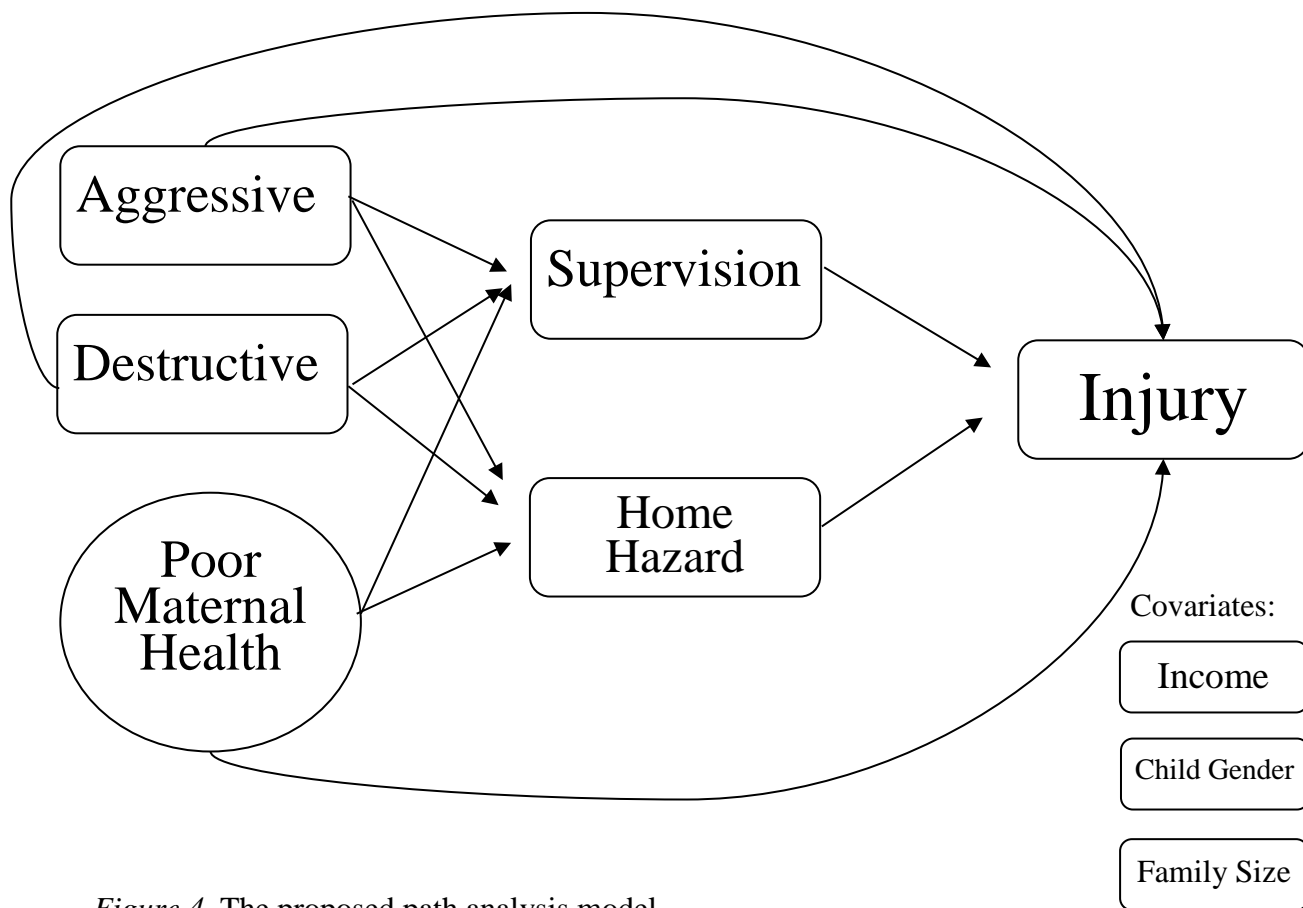


Figure 4. The proposed path analysis model.

A single path analysis model addresses all research questions. Thus in the proposed model (Figure 4), child externalizing behavior (destructive and aggressive subscales), and maternal health are tested as predictor variables. Parent supervision and environmental hazards are tested as mediator variables. Injury is used as a dichotomous outcome measure (child was injured in the past year or child was not injured in the past year). Injury is being measured dichotomously because prior research examining child injury with the Fragile Families data (Crandal, Sridharan & Schermer, 2010; Sridharan & Crandall, 2011; Turney 2011, 2012) has determined that there are too few multiply injured participants in a one year span of time to

examine the frequency of injuries in a one year period of time. Poor maternal health is a constructed latent variable composed of four items: maternal BMI, self-rated health, number of prescribed medications taken, and the presence of serious health problems that limited the mother's ability to work. Covariates of child gender, family income and family size are included in the path analysis, as a great deal of literature has demonstrated that rates of injury vary by these factors (e.g., Baker, O'Neill & Ginsburg, 1992; CICH, 1994; Rivara et al. 1982).

The following research questions are posed:

- 1) Does child externalizing behavior (aggressive and destructive) predict the occurrence of child injury?

It is hypothesized that children with more externalizing behaviors will also have more reported injuries. The aggressive and destructive subscale scores will be assessed as predictor variables as existing literature has identified externalizing behavior as predictive of injury. This analysis will determine if child injury is truly affected by a child's aggressive and/or destructive problem behaviors.

- 2) Does maternal physical health predict the occurrence of child injury?

It is hypothesized that children whose mothers are physically unhealthy will more frequently report injury having occurred in a 12 month period than children whose mothers do not have physical health problems. Maternal health is conceptualized as a latent construct composed of maternal BMI, self-rated health, health-related limitations to work and medications being taken for an illness. The purpose of this analysis is to determine if children's risk of injury differs as a function of their mothers' health behaviors.

- 3) Does parent supervision mediate the relation between child externalizing behavior (aggressive and destructive) and child injury?

It is hypothesized that supervision will mediate the relation between child externalizing behavior and child injury such that children with more externalizing behavior problems will have less occurrence of injury with the presence of supervision. This is hypothesized because existing literature has identified supervision as protective of injury in children with behavior problems (Morrongiello, Ondejko & Littlejohn, 2004a & 2004b; Davidson, 1987; Rowe, Maughan & Goodman, 2004; Schwebel, Speltz, Jones & Bardina, 2002). The purpose of this analysis is to determine if the risk of injury in children with behavior problems differs based on the presence or absence of supervision.

- 4) Does environmental hazard mediate the relation between child externalizing behavior (aggressive and destructive) and child injury?

It is hypothesized that environmental hazard will mediate the relation between child externalizing behavior and child injury such that children with more externalizing behavior problems will have less occurrence of injury when no environmental hazards are present. This is hypothesized because existing literature has identified environmental hazards as predictive of injury (e.g., Myer, Roelofs, Bluestone, 1963; Spiegel, Lindaman, 1977; Wilner, Walkley, Pinkerton, & Tayback, 1962), though no study has examined the role of environmental hazards as a mediator of the externalizing behavior-injury relationship. The purpose of this analysis is to determine if the risk of injury in children with behavior problems differs based on the presence or absence of environmental hazards in the home.

- 5) Does parent supervision mediate the relation between maternal physical health and child injury?

It is hypothesized that supervision will mediate the relation between maternal physical health and child injury such that children whose mothers have more health problems will have a decreased occurrence of injury when supervised. This is hypothesized because existing literature has shown that supervision is a predictor of child injury (Garling & Valsiner, 1985; Plumert, 1995, Plumert & Schwebel, 1997; Schwebel & Bounds, 2003; Valsiner & Lightfoot, 1987). No study has examined the role of parent supervision as a mediator of the parent physical health-injury relationship. The purpose of this analysis is to determine if the risk of injury in children whose parents have more health problems differs based on the presence or absence of supervision.

- 6) Do environmental hazards mediate the relation between maternal health and child injury?

It is hypothesized that environmental hazard will mediate the relation between maternal physical health and child injury such that children whose mothers have more health problems will have a greater occurrence of injury when environmental hazards are present. This is hypothesized because existing literature has identified parental involvement in their child's environment as a mediator of the relation between maternal mental health and child injury (e.g., Leiferman, 2002; McLennan & Kotelchuck, 2000; Mulvaney & Kendrick, 2006). While maternal mental health has been examined as a predictor of child injury with child environment as a mediator, no study has examined the role of environmental hazards as a mediator of the parent

physical health-injury relationship. The purpose of this analysis is to determine if the risk of injury in children whose parents have more health problems differs based on the presence or absence of environmental hazards in the home.

Results

Sample Demographics

Table 1

Demographic characteristics of participants

	n	%
Total Mother Participants	3288	
Child Gender		
Male	1722	52.4
Female	1566	47.6
Mother's Education Level		
less than h.s.	1283	39.0
h.s. or equivalent	832	25.3
some college or tech school	819	24.9
college or graduate school	350	10.6
Race		
White, non-Hispanic	714	21.7
Black, non-Hispanic	1604	48.8
Hispanic	845	25.7
other	116	3.5
Mother's relationship to father		
Married	1032	31.4
Romantic cohabitation	640	19.5
Romantic with some visit.	73	2.2
Romantic with no visit	109	3.3
Separated, widowed or divorced	215	6.5
friends	595	18.1
No relation	612	18.6
Father unknown	8	.2

Table 2

Demographic variables of participants

	M	SD
Child Age (months)	35.64	2.47
Mother Age (years)	28.07	6.07
Mother Income (U.S. dollars)	27,017.59	44711.96
People living in home (not including mother)	4.54	1.69

Latent Variable Construction

First, the latent variable of maternal health was created from maternal responses to items about health conditions affecting their ability to work, self-rated health, height and weight (from which BMI was calculated), and medications being taken for a health condition. When these four variables were correlated with the latent variable maternal health, this model fit the data well, χ^2 (2, N = 4220) = 8.54, $p = .01$, CFI = 1.00, and RMSEA = 0.01 indicating that the items included in the latent variable were all representative of the same construct. Thus, the latent variable Poor Maternal Health was used in subsequent analyses to represent the composite of these items in one construct.

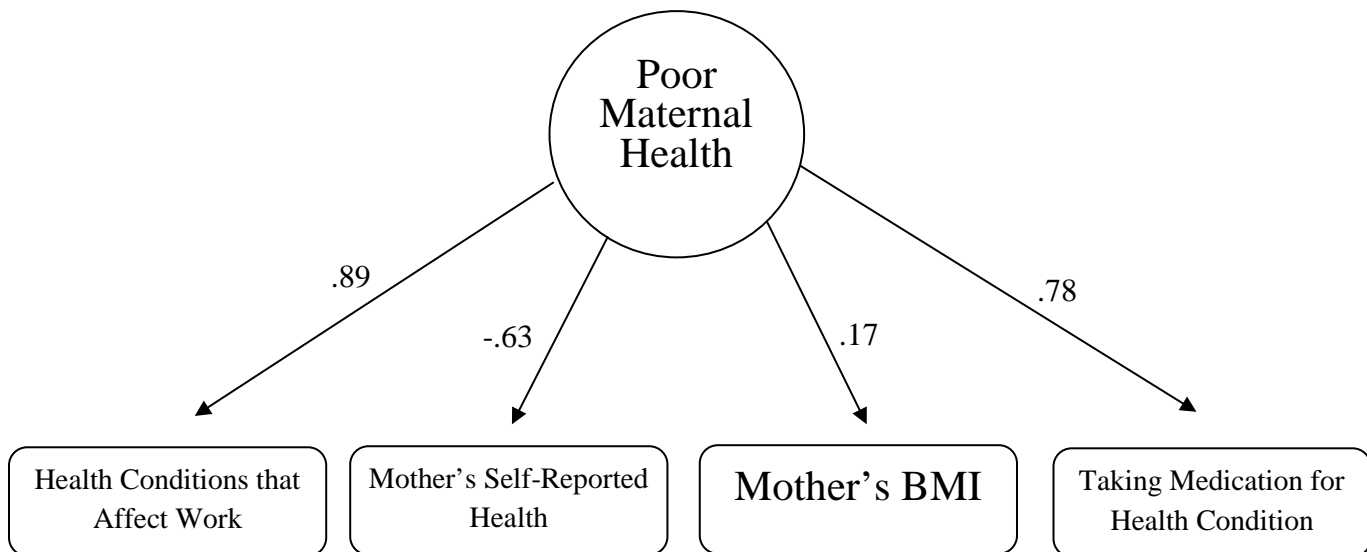


Figure 5. Poor Maternal Health as a latent measure of four indices of mother's health.

Path Analysis

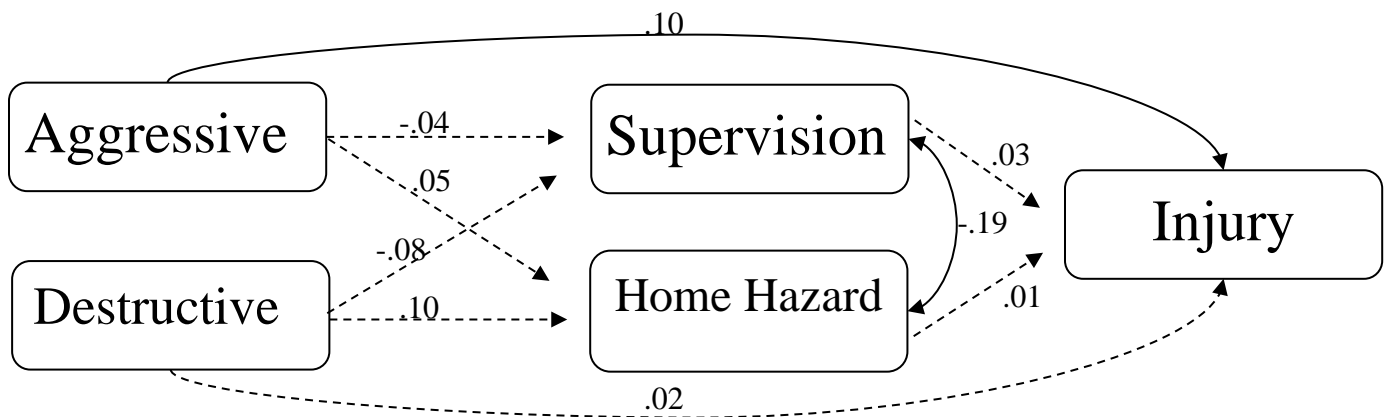


Figure 6. Supervision and home hazard as mediators of the relation between aggressive and destructive child behavior and child injury. Broken lines indicate non-significant relations.

It was hypothesized that children with more externalizing behaviors (both aggressive and destructive) would also have more reported injuries. This hypothesis was only partially supported. Figure 6 depicts the first tested portion of the proposed model. This model tested the externalizing child behavior variables of aggressive and destructive behavior as predictors of child injury. Parent supervision and home environment hazard were tested as mediators of this relation. Analyses revealed that child aggressive behavior score predicted the occurrence of child injury ($\beta=.10$, $p=.014$) such that increased behavior score was associated with the occurrence of injury. Analyses also showed a significant relation between parent supervision and home environment hazard ($\beta=-.19$, $p=.007$) such that less supervision was associated with more hazard. No significant associations were found between aggressive behavior and supervision ($\beta=-.04$, $p=.421$), destructive behavior and supervision ($\beta=-.08$, $p=.115$), aggressive behavior and home environment hazard ($\beta=.05$, $p=.397$) or destructive behavior and environment hazard ($\beta=.10$, $p=.098$). Additionally, no significant relations were identified between

supervision and injury ($\beta=.03, p=.613$) or home environment hazard and child injury ($\beta=.01, p=.845$).

Given the many non-significant associations found in this model, a modified model examined aggressive behavior and destructive behavior as predictors of child injury without consideration of mediators. As destructive behavior again failed to predict child injury ($\beta=.014, p=.722$) it was dropped from further analyses. Aggressive behavior continued to predict the occurrence of child injury ($\beta=.08, p=.014$).

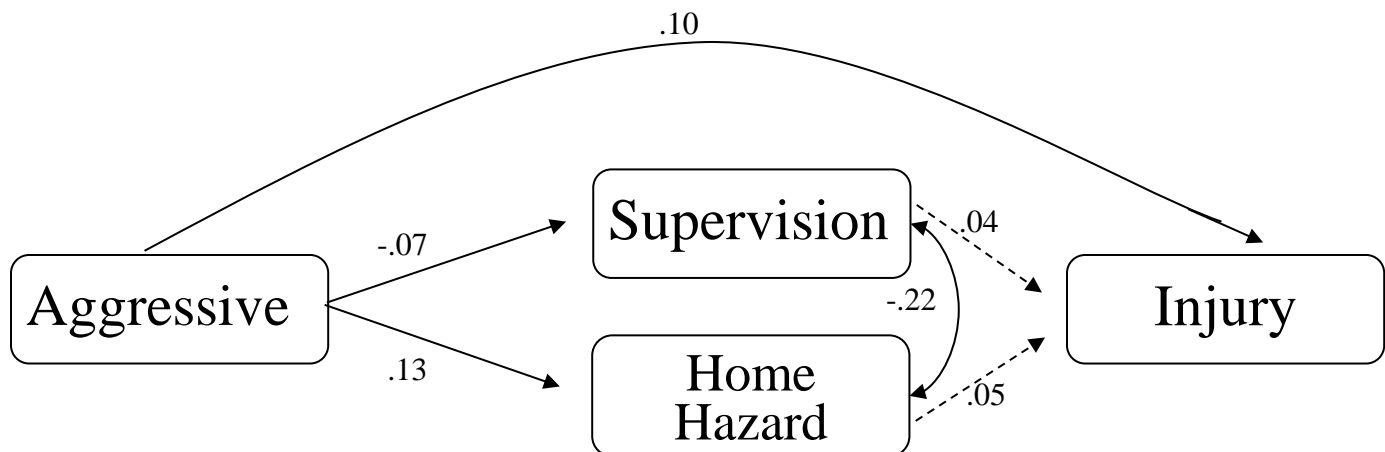


Figure 7. Model of supervision and home hazard as mediators of the relation between aggressive behavior and child injury. Broken lines indicate non-significant relations.

An additional model examined supervision and home hazard as mediators of the relation between aggressive behavior and child injury. Aggressive behavior was a significant predictor of supervision ($\beta=-.07, p=.041$) and home hazard ($\beta=.13, p=.000$) such that higher levels of aggressive behavior were associated with less supervision and more hazard. Aggressive behavior was also a significant predictor of injury ($\beta=.10, p=.000$) such that higher levels of aggressive behavior were associated with the occurrence of injury. Supervision was not a significant predictor of child injury ($\beta=.04, p=.465$) nor was home hazard ($\beta=.05, p=.447$).

Upon determining that aggressive behavior is a predictor of injury, maternal health was added to the model as a predictor of injury. It was hypothesized that children whose mothers were in poorer physical health would more frequently report injury having occurred in a 12 month period than children whose mothers did not have physical health problems. Maternal health was used as a predictor in the following model that assessed the fit of aggressive behavior and poor maternal health as predictors of injury when mediated by parent supervision and home environment hazard report. Figure 8 depicts this model. When the model was tested, aggressive behavior and poor maternal health were both found to be predictors of injury ($\beta=.10, p=.000$; $\beta=.13, p=.001$), such that higher levels of aggressive behavior and poor maternal health were associated with the occurrence of injury.

It was hypothesized that supervision would mediate the relation between child externalizing behavior and child injury such that children with more externalizing behavior problems would have less occurrence of injury with the presence of supervision. It was also hypothesized that environmental hazard would mediate the relation between child externalizing behavior and child injury such that children with more externalizing behavior problems would have less occurrence of injury when no environmental hazards were present. Neither of these hypotheses were supported by the data. Aggressive behavior was determined to be a predictor of supervision ($\beta=-.07, p=.041$) and home hazard ($\beta=.13, p=.000$). Higher levels of aggressive behavior were associated with less supervision and more hazardous home environment.

It was hypothesized that supervision would mediate the relation between maternal physical health and child injury such that children whose mothers had more health problems would have a decreased occurrence of injury when supervised. It was also hypothesized that environmental hazard would mediate the relation between maternal physical health and child

injury such that children whose mothers had more health problems would have a greater occurrence of injury when environmental hazards were present. Neither of these hypotheses were supported by the data. In this model however, maternal health was not found to predict supervision ($\beta = -.06, p = .209$) or home hazard ($\beta = -.00, p = .986$). Supervision ($\beta = .05, p = .389$) and home hazard ($\beta = .05, p = .427$) also failed to predict child injury. Thus, in this model, supervision and home hazard did not mediate the relation between aggressive behavior and injury or maternal health and injury. These findings do not support the hypotheses.

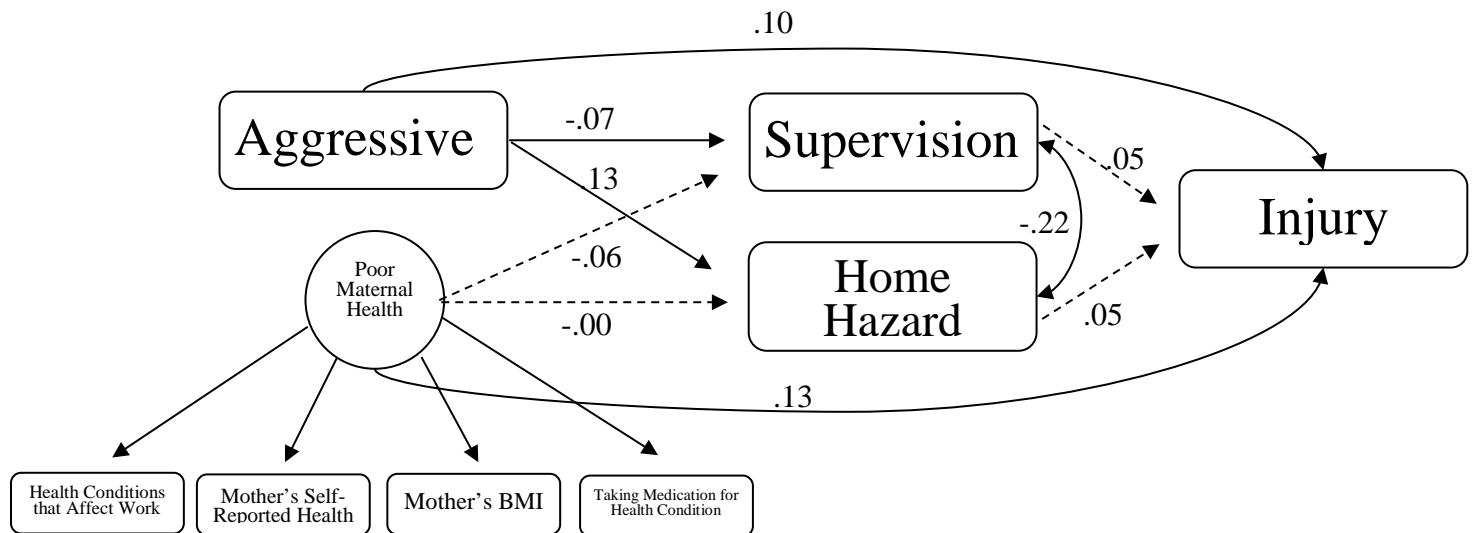


Figure 8. Model assessing the fit of supervision and home hazard as mediators of the relation between aggressive behavior and poor maternal health, and injury. Broken lines indicate non-significant relations.

Because supervision and environmental home hazard were not mediators of the relation between aggressive behavior and injury or maternal health and injury, a model was tested which included only aggressive behavior and maternal health as predictors of injury (Figure 9). This model fit the data well, $\chi^2 (9, N = 3172) = 141.73, p < .001, CFI = .913$, and $RMSEA = 0.07$.

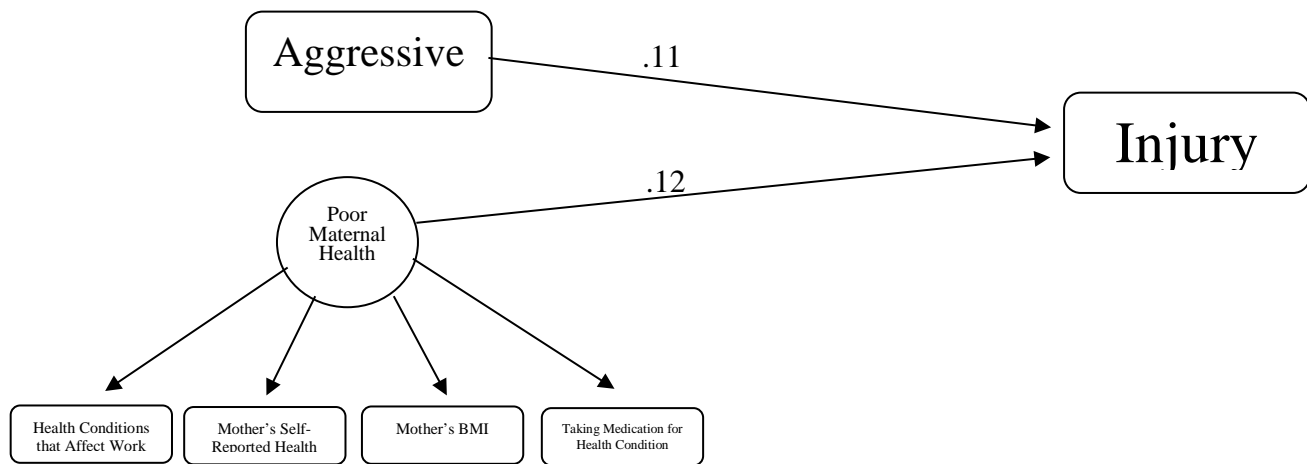


Figure 9. Aggressive behavior and maternal health as predictors of child injury. Broken lines indicate non-significant relations.

Upon determining that aggressive behavior and maternal health significantly predicted the occurrence of child injury, the model was again tested, this time including the covariates of family income, child gender, and family size. After the variance of these three variables was accounted for in the model, poor maternal health ($\beta=.13, p=.002$) and aggressive behavior ($\beta=.08, p=.003$) remained significant predictors of maternal health. Poorer maternal health was associated with the occurrence of injury as was higher levels of aggressive behavior. This model continued to fit the data well, $\chi^2 (17, N = 3270) = 55.91, p < .001$, CFI = .977, and RMSEA = 0.03.

Table 3

*Covariate effects for variables included in the final model. Note; * $p < .05$; ** $p < .01$.*

Variables	Income	Child Gender	Family Size
Aggressive	-0.09**	-0.05**	0.04*
Poor Maternal Health	-0.11**	-0.01	0.07**
Injury	0.08	0.04*	0.01

Discussion

The current study was designed to examine the associations between child behavior, maternal health, maternal supervision and environmental home hazard as they predict child injury. Several findings emerged, and these findings should inform later research examining risk factors for child injury as well as the development of injury prevention interventions. The use of these findings will be especially important to consider when conducting research and developing interventions with fragile families and vulnerable populations. The findings of this study are somewhat, but not completely consistent with the conceptual model proposed by Barbara Morrongiello (2005; Figure 1). This model proposed that caregiver, child and environmental variables interact within sociocultural variables. While the model tested in this study demonstrated associations between some caregiver characteristics (maternal health) and child-based variables (child behavior), a second caregiver characteristic (supervision) and the environment-based variable (home environment hazard) were not significant predictors of injury and did not fit in the proposed model. Consistent with Morrongiello's conceptual model, sociocultural variables (income, gender, family size) were considered in the proposed model and accounted for some variance in child injury. The following discussion will identify relevant findings of this study, highlight the fit of the final model with Morrongiello's conceptual model and the proposed model, and examine how these findings can be used to inform later research and intervention. Further, strengths, limitations, and future directions for research will be discussed.

Overview of Specific Aims and Findings

A series of data analyses yielded several significant findings. A path analysis was conducted to determine the fit of the proposed model with the data. In line with the first specific aim, a first analysis revealed that while aggressive behavior was a predictor of child injury,

destructive behavior was not. Subsequent analyses using child externalizing behavior as a predictor only included aggressive behavior. The latent variable “poor maternal health” was constructed using four maternal self-report items. In fulfillment of the second specific aim, four items (conditions affecting ability to work, mother’s self-reported health, mother’s BMI, and medications being taken for a health condition) were then assessed along with aggressive behavior as predictors of child injury. To assess the third and fourth specific aims, supervision and home environment hazard were included as mediators in this model. Results revealed that while aggressive behavior remained a significant predictor of child injury, poor maternal health was also a predictor of child injury, whereas supervision and home hazard did not mediate this relation. A final model eliminated supervision and home hazard and included covariates of family income, family size, and child gender. This final model fit the data well and showed that higher scores on the aggressive subscale of the child behavior measure were associated with increased occurrence of injury and poorer maternal health was associated with increased child injury. These associations remained above and beyond considering family income, family size and child gender.

Child Behavior and Child Injury

Child aggressive behavior was a consistently significant predictor of the occurrence of child injury in analyses of these data such that higher scores on the aggressive subscale of the behavior measure were consistently associated with the occurrence of injury. This finding was consistent with hypotheses and means that aggressive behavior may be associated with child injury. Consistent with existing literature, child externalizing behavior was predictive of child injury such that more aggressive behavior was associated with increased occurrence of injury. It

is important to point out, however, that *only* aggressive child behavior (and not destructive child behavior) was predictive.

Existing literature that has examined child behavior as a predictor of child injury has mostly focused on ADHD (DiScala et al., 1998; Farmer & Peterson, 1995; Schwebel, Speltz, Jones, Bardina, 2002; Spinks et al., 2008) or ODD and CD (Davidson, 1987; Jacques & Finney, 1994; Rowe, Maughan & Goodman, 2004; Schwebel, Speltz, Jones & Bardina, 2002) as predictors of child injury though a great deal of debate exists within the field about which of these are true predictors of injury. Researchers have argued that it is actually ODD and/or CD traits within children with ADHD that put them at greater risk for injury (Byrne et al., 2003). In the current study, child externalizing behavior was looked at as aggressive or destructive, and was based on the scores that children received on each of the corresponding subscales of the behavior checklist. The examination of externalizing behavior in its separate aggressive and destructive parts differs from existing literature, but may provide further explanation for the conflation of ADHD and ODD/CD as predictors of injury. Given the finding that aggressive behavior predicts child injury, it may be that the aggressive traits exhibited by children with ODD/CD/ADHD are the mechanism of action within the previously identified relation found between these disorders and injury. However, as the current study did not consider externalizing disorders specifically within analyses, this explanation can only be speculated and not confirmed.

This explanation can be further supported by existing knowledge in the field of psychology that aggressive behavior (as described in the behavior survey) is a major component of externalizing disorders like ODD and CD (American Psychiatric Association, 2013) and common among children with ADHD (e.g., Biederman, Petty, Clarke, Lomedico & Faraone, 2011). Destructive behavior is also a significant characteristic of both ODD and CD (American

Psychiatric Association, 2013). The finding that aggressive but not destructive behavior predicts injury in the current study shows that the destructive part of ODD and CD may not be responsible for injury risk, though aggressive behavior may be.

The findings of the present study additionally lend support to the findings that Spinks and colleagues (2008) identified. They posited that it was not actually behavior problems in children that were predictive of child injury, but the commonly comorbid low SES and maleness that accompanied behavior problems. However, after testing this hypothesis it was found that child behavior is a significant predictor of child injury even after accounting for demographic variables like SES and gender. The present study found similar results.

Maternal Health and Child Injury

Consistent with the stated hypothesis, the current study identified maternal health as a predictor of child injury such that poorer maternal health was associated with the occurrence of injury. No studies that the author could identify have tested how these two variables relate. Thus, the current study is the first to consider parent physical health factors as predictors of child injury. As many studies have identified poor parent mental health as predictive of child injury (e.g., Husband & Hinton, 1972; Speltz, Jones & Bardina, 2002), the current study assumed that parent physical health may similarly affect child injury and hypothesized that poor parent physical health would predict child injury.

Interestingly, while the current study found that, like poor maternal mental health, poor maternal physical health is associated with increased occurrence of injury, it seems that these two constructs of problematic health increase the risk of injury in different ways. According to studies conducted by Leiferman (2002), McLennan et al. (2000) and Mulvaeney et al. (2006), the risk of injury in children increases when parents have mental health problems. These studies

support the idea that this is because mentally unhealthy parents have less engagement in their children's environment and practice fewer preventative strategies. In other words, parents with poor mental health supervise less and have less safe home environment conditions, which cause an increase in injury. As can be seen in the results of this study, less supervision and poorer home environment conditions were not associated with an increased rate of injury in children with mothers with poor physical health. Thus, while mental health problems may affect a parent's supervision and control of their home environment, physical health likely increases the rate of injury through some other mechanism of action. As this study is the first to examine the impact of parent physical health on child injury, future research should verify this finding and further elaborate on the mechanisms of action in this relation. After further clarification of why poor maternal health is a risk factor for child injury, injury prevention interventions should target parents in poor physical health and intervene with the eventually identified mechanisms of action. Even without further clarification of the mechanisms of action, interventions might consider targeting parents with poor physical health as the present study's findings suggest that their children are likely at increased risk of injury.

Parent Supervision as a Mediator

One aim of the current study was to determine if parent supervision mediated the relations between child behavior and child injury and maternal health and child injury. This hypothesis was not supported by findings. Studies have previously examined this question using a variety of measures of behavior and injury (Morrongiello et al., 2004; Davidson, 1987; Rowe et al., 2004; Schwebel et al., 2002) and have found that supervision moderates the behavior-injury relationship. In the current study increased aggressive behavior was significantly associated with a lack of supervision, but supervision did not mediate the relation between aggressive behavior

and injury. This is because results failed to demonstrate a significant relation between supervision and injury.

Child behavior and supervision. A significant relation was found between aggressive behavior and supervision such that increased aggression was associated with decreased supervision. As the Fragile Families 3-year follow-up data are cross-sectional in nature, it is difficult to identify whether aggressive behavior is a result of a child being less supervised or that less supervision takes place because of a child's aggressive behavior. An early study by Baden and Howe (1992) compared 40 parents of children with conduct disorder to 40 parents with matched control children and found that parents of children with conduct-disorder believed that their child's behavior was more attributable to causes outside of their control than control group parents. This finding indicates that it could be that if a child is aggressive, then that child's parent may feel incapable of modifying or controlling that child's behavior and subsequently stop supervising or decrease supervision. It is also possible that when parents do not supervise, their children are not instructed that aggressive behavior is unacceptable.

A third explanation is that some third factor similarly affects both supervision and aggression. One such factor may be parent mental health. A depressed parent may supervise less because of the limitations of his/her symptoms of depression. A number of studies have found that parents who are depressed have decreased engagement in their children's environments and practice fewer preventative strategies (Leiferman, 2002; McLennan & Kotelchuck, 2000; Mulvaney & Kendrick, 2006). At the same time, that depression may influence a child to behave aggressively for attention, or because he/she has not been taught behavior self-management.

Maternal health and supervision. An association between parent physical health and supervision, as far as the author could identify, has not been found in existing research. The current study did not find a significant association between these two variables, which could have resulted from a number of causes. One of these is that the measure of maternal health used in this study was not an adequate measure or truly representative of maternal participant's health. The measure of maternal physical health used in this study only encompasses one component of physical health and it is possible that other measures of physical health would be more predictive. For example, it is possible that measures of health behaviors (e.g., smoking, drinking alcohol, exercising) would be more predictive of child injury than the measure of illness- and disability- related health used in the present study. Another possible explanation is that physical health is truly unrelated to parent supervision. It may be that while many factors influence the extent to which a parent supervises (including a child's behavior), maternal health is not one of these factors. It could also be that parent depression and parent physical health affect parents' abilities to supervise differently such that depression prevents a parent from actively supervising whereas poor physical health (as measured in this study) does not prevent a parent from being physically active. Similarly, it is possible that BMI alone, especially high BMI, would affect the extent to which a parent supervises, while the impact of this single variable was diluted with the inclusion of other measures of health in the "poor maternal health" latent construct. It is clear that further research is necessary to clarify how parent physical health impacts the use of parenting skills.

Supervision and injury. Many studies have shown that increased supervision is associated with decreased injury (e.g., Garbarino, 1988; Schwebel et al., 2006). Thus, the

identified lack of significant association between supervision and injury in this study is especially surprising.

A number of explanations can be offered for the absence a significant relation. First, it could be that the measure of supervision used in the current study inadequately represented the construct of supervision. Previous research has measured supervision with many different methodologies and definitions. These studies have measured supervision as the acknowledgement of behavioral risk taking (Schwebel et al., 2006), beliefs about supervision using the Beliefs about Supervision Questionnaire (Morrongiello et al., 2004a & 2004b), parent protectiveness using a rating scale, identification of which parent was supervising at the time of injury, location of injury during supervision (2004b), type of supervision (i.e., environmental protection or instructional), accuracy of estimation of the child abilities (Russell, 1998) and proximity to the child (Garling & Valsiner, 1985; Plumert, 1995; Plumert & Schwebel, 1997; Schwebel & Bounds, 2003; Valsiner & Lightfoot, 1987). Problematically, many types of supervision measures have been used in the existing research, making it difficult to define the construct. Most commonly proximity is used as a measure of supervision.

The present study used an observational measure of supervision, and attempted to measure supervision through proximity (as most studies have); however, the measure may not have been adequate. During home visits, researchers observed the home environment and responded to the item “parent kept child in visual range when child was not cared for by someone else, looked often at (him/her) (often means enough to ensure safety of child and to keep some kind of interpersonal contact with (him/her).” Possible responses included “in range” and “not in range.” While observational measures are generally considered the “gold standard” in research, this is only the case if that which is being measured is operationalized adequately.

Unfortunately, supervision may not have been adequately operationalized in the current study, thus leaving the presence or absence of the behavior open to interpretation without checks to fidelity. This lack of clarity about how to rate this item likely led to inconsistent ratings. It is possible that this inconsistency explains why the current study found that supervision did not significantly predict injury while many studies have found this in the past.

Home Environment Hazard as a Mediator

A final aim of the current study was to determine if child home environment hazard mediated the relations between child behavior and child injury and between maternal health and child injury. It was hypothesized that mothers in poor health would have children with more injuries due to more environmental hazards. A similar relationship was hypothesized for child behavior and it was anticipated that children with more behavior problems would be more frequently injured with more environmental hazards. Previous studies have examined how home environment hazard impacts the risk of child injury (Rowntree, 1950). As no studies have examined the relation between parent physical health and child injury, this field of research has not advanced enough to determine mediators of the relationship, including environmental hazard. In the current study poor maternal health was not associated with home hazard. Increased aggressive behavior was associated with more home hazard. The presence of home hazards was not significantly related to the occurrence of child injury. Thus, home environment hazard did not mediate the relation between child behavior and child injury or the relation between maternal health and child injury. These findings were inconsistent with those that were hypothesized.

Child behavior and environment. In this study, increasingly aggressive child behavior was associated with the presence of home hazard. Existing literature has not examined the relation between child behavior and child home hazard or environment conditions. The present

study was the first to explore this relation. Some related literature has shown that parental involvement in a child's environment can moderate the risk of injury in children with behavior problems, though these studies tend to focus more on parental supervision within the child's environment than environmental characteristics (e.g., Davidson, 1987; Rowe, Maughan & Goodman, 2004; Schwebel, Speltz, Jones & Bardina, 2002). Child aggressive behavior significantly predicted environmental hazard in the current study, and was the only significant relation with environmental hazard within the paths examining environmental hazard as a mediator. This finding indicates that there is some characteristic of aggressive behavior in children that increases the occurrence of home environment hazard, or there is some characteristic of home environment hazard that is associated with increasingly aggressive child injury. One possible explanation is that because aggressive children require additional attention from their parents, the parents may have neglected maintaining the home environment and instead attended to their child. This attention may not necessarily be in the form of supervision, as the current study found decreased supervision with increased aggression. It may be that the increase in home hazard with increased aggression found in this study resulted from a focus on instructional strategies to the neglect of home conditions. If this is the case, parents' efforts and energy may have been focused on instructional strategies rather than the maintenance of their home environment.

Maternal health and environment. In this study, poor maternal health was not associated with home hazard. This is an interesting finding given that the literature identifies poor parent mental health as a predictor of decreased engagement in a child's environment (e.g., (Leiferman, 2002; McLennan & Kotelchuck, 2000; Mulvaney & Kendrick, 2006); however, these studies examined parent's efforts to engage in *preventative* strategies, whereas the present

study examined the impact of parent physical health on passive environmental conditions (i.e., the physical condition of the home). These findings further demonstrate that while parent physical health problems and parent mental health problems may similarly impact a child's risk of injury, they may do so through different mechanisms. While parental engagement in their child's environment may be the mechanism of action in the parent mental health- injury relationship, there is some other mechanism of action in the parent physical health- injury relationship.

Home environment and injury. The finding that home environment hazard was not significantly associated with an increase in child injury was contrary to the majority of existing literature that has examined this relation. A number of studies (e.g., Myer et al., 1963; Spiegel et al., 1977; Wilner et al., 1962) have identified links between environmental hazards and housing conditions, and child injury. All published studies have found a significant relation between environmental factors and child injury though it is possible that unpublished research has failed to identify a significant relation between these variables. The failure to identify this association may be attributed to a number of possible causes. One of these is that the measure used to evaluate the presence or absence of home environment hazard was inadequate. The current study examined environment hazard through one item that required the researcher to observe the child's home conditions and report "yes" or "no" to the prompt, "is environment inside home unsafe for young children? Answer 'yes' if one or more potentially dangerous health or structural hazards." As this measure did not account for the degree of environmental hazard, it is possible that many of those homes reported hazardous were only hazardous because of a single potentially dangerous hazard. It is likely that a single hazard did not create a hazardous enough environment to significantly influence a child's risk of injury. Similarly, most other studies that

have found the association between child injury and environmental hazard have measured environmental hazard through examination of specific environment characteristics (e.g., safety plugs in outlets, padding tables, locking cupboards; Morrongiello et al., 2004b). It is possible that certain home hazards are more predictive of injury than others; therefore, the current study may have been more likely to have found environmental hazard predictive of injury with more specific examination of home hazards.

Another possible explanation for the disparate findings of the current study from prior research is that most of the reviewed studies examining the relation between maternal health and environmental safety have looked at parents' active environmental prevention strategies (e.g., safety plugs in outlets, padding tables, locking cupboards; Morrongiello et al., 2004b) as opposed to the passive environmental conditions examined in this study (e.g., falling plaster, broken stairs, flames within a child's reach, weapons within reach). The environmental prevention strategies examined in existing literature require an additional degree of effort and prevention than the measures in the current study. In the current study, home hazards are descriptive of dilapidated homes and neglectful home-keeping. It is likely that the base-rate of neglect-related home hazard is comparatively less than the base-rate of the absence of preventative environmental conditions. These differing frequencies likely affect the risk of injury differently in statistical analyses.

The Fragile Families Sample

The results of this study are particularly valuable given the Fragile Families sample in which they were found. The Fragile Families sample is representative of births in the 77 U.S. cities with populations over 200,000 with an overrepresentation of disadvantaged and vulnerable families, particularly, unmarried parents and their children. These families are more likely to

possess characteristics that put them at greater risk for a number of negative health and behavioral outcomes including increased risk of injury, overcrowded homes and poor housing conditions. Because of the unique characteristics of this sample, it is important to consider the results of this study within their context. The findings of this study revealed that children with aggressive behavior and parents in poor physical health are at increased risk of injury. This is important to consider in light of research that has identified children from unmarried families as at higher risk for emotional and behavioral problems (Ackerman, D'Eramo, Umyln, Schultz, & Izard, 2001; Luoma et al., 1991). This means that while the present study has identified children with aggressive externalizing behavior as being at higher risk for injury, children from single-parent families may be at even greater risk for injury because they more frequently have behavior problems. Similarly, as mothers of non-marital births and lone mothers are at increased risk of physical health problems (Baker & North, 1999; Fritzell, Weitoft, Fritzell & Burstrom, 2007; Williams, Sassler, Frech, Addo & Cooksey, 2011), and children whose parents have poorer health have more injuries, children of single mothers will be an important population to target with future research and intervention.

Areas for Future Exploration

Strengths. There are a number of strengths in the design of this study. The large sample in this study increased internal validity, and the nationally representative population allows for a great deal of generalizability of results to a wide population. Random selection is another strength of this study. Hospitals, and subsequently patients, were randomly selected using random stratification of cities, random selection of hospitals within cities and a bed numbering system in each hospital. Similarly, as the sample over-represents single parents and minorities,

the results of this study will especially represent those populations that are generally less examined in research.

One of the greatest strengths of this study is that it is the first to examine parent health as a predictor of child injury. Identifying this relation allows researchers and practitioners to be aware of the increased risk of injury in children whose parents are in poorer health that will also assist in decreasing the occurrence of injury in these children. The determination of maternal health as a predictor of child injury is especially profound as the measure was based on multiple indicators of maternal health (i.e., BMI, reported limitations to work, self-reported health and taking medications for health conditions) whereas many studies only use self-reported health as a predictor variable.

Another strength of the present study is that it was the first to attempt to include the most commonly reported factors associated with injury (child behavior, parent supervision, home environment and maternal health) in one conceptual model. While supervision and home environment did not fit the proposed model, this finding informs the field of injury research that there are some other mechanisms of action in the relationships between child behavior and child injury and maternal health and child injury. Thus, this study contributes significantly to the existing body of child injury literature and makes an especially significant contribution to injury research examining fragile families.

Limitations. A limitation of the current study is that constructs are not well defined due to very broad and general item prompts and questions. For example, it is questionable whether or not a participant's response to the prompt regarding medications being taken is representative of the construct "physical health." Because this item asks parents to identify for which disorders they are currently taking medication, a group of participants who cannot afford a diagnosis or

medication may not be included in the definition of “unhealthy”, when they may be equally unhealthy as those who reported being on medication. Similarly, a mother must know that she is taking medication and for what she is taking medication in order to be able to assert that she has a disorder for which she is taking medication. Many individuals do not have the health literacy required to accurately make this assertion, especially individuals from vulnerable populations (DeWalt, Berkman, Sheridan, Lohr, & Pignone, 2004). This being said, defining part of poor physical health as taking medication for a disorder ensures that measures of physical health are objective and not left to the participant to determine.

Likewise, measures of supervision and home environment hazard used in this study did not provide enough information about the context of the supervision behavior or home environment hazards. These measures only identified whether or not there was supervision and hazards in the home environment. More descriptive reports of each of these observations would allow for better assessment of their role in the occurrence of injury. Similarly, while the behavior checklist used in the current study was derived from the CBCL (Achenbach, 1998) it is not the well validated CBCL and therefore may not represent the constructs of aggressive and destructive behavior as accurately as the CBCL.

The fact that the current study is a secondary analysis of pre-existing data limits the possibility of checking for any data collection inaccuracies or making any modifications to the design. Another limitation is that data were collected retrospectively, and are therefore dependent on parental recollection of injury events. Similarly, most items used from the Fragile Families study are self-report in nature, which limits the possibility of verifying response accuracy. Some items are also dependent on a single in-home interviewer’s ratings and there are no checks on the fidelity of these measures.

Additionally, this study only assessed maternal health and not paternal health. This is unfortunately consistent with most studies of child-parent factors, and fathers continue to be underrepresented in child research. Future research should consider the role of fathers in the occurrence of injury in children. This is especially important when considering the role of parental health in the occurrence of injury as different types of physical health conditions affect males and females to varying degrees. These different health conditions could affect child injury risk differently, which is an important consideration with the development of injury prevention interventions.

Further, recent research has found that a father's socioeconomic status affects his alignment with his role as a "masculine protector," which subsequently affects the ways that he works to prevent injury (through purchasing of equipment or child-centered approaches; Olsen, Oliffe, Brussoni & Creighton, 2013). Given the understanding that fathers and mothers make decisions about how to prevent injury differently, it will also be important to consider these prevention approach differences when creating injury-prevention interventions.

Finally, this study lacks inclusion of items questioning the severity of child injuries, determined some city sampling choices based on funding sources' interests (Reichan, Teitler, Garfinkel & McLanahan, 2001), did not indicate the intentionality behind injury or specific injuries sustained, and unintentionally underrepresented Latino families (as a result of study locations and exclusion criteria).

Further research. Taken together, the findings of the current study and previous research indicate that future injury research should attempt to target vulnerable families, especially single parent families. These families are at higher risk for injury when they have children with aggressive behavior and/or mothers in poor physical health, and therefore would

most strongly benefit from intervention. As single-parent families have unique needs and fewer resources compared to co-parenting families, research will need to account for and consider these findings by determining how to prevent injuries using as few parent resources (e.g., time and money) as possible.

Beyond this, future research should also continue examining maternal physical health as a risk factor for child injury. As the current study is the first to examine this relation, additional research is required to determine the mechanisms of action within this relation. Determining why parents in poor health have children with higher risk of injury will allow researchers to develop interventions targeting the mechanisms of action in that relation. The current study identified that these children may not necessarily be at greater risk for injury because of increased environment hazards or decreased supervision, but there may be some other characteristic of parent physical health (e.g., lower income, increased time at work to pay bills, increased time spent outside of the home) that increase the occurrence of injury. Further research should also examine the differences between the mediators of parent physical health and child injury and mental health and child injury. Further defining these differences will allow researchers to determine if one type of intervention is appropriate for all parents with health conditions or if different interventions must be created for parents with physical health conditions and parents with mental health conditions.

It will also be important that future research clarify the role of aggressive behavior in child injury. It will be especially important to verify the supposition made in this study that aggressive behavior is responsible for child injury in children with ODD, CD, and ADHD. If aggressive behavior can be identified as the mechanism of action in the relation between ODD/CD/ADHD and injury, then further research, and subsequent interventions, can target

aggressive behavior specifically, and more efficiently decrease the occurrence of injury. This would advance the field as there is currently a great deal of debate over which disorder (or characteristics of the disorders) is associated with the occurrence of injury.

After further research verifies the findings in the current study and determines the reasons for which parents in poor health have children at higher risk of injury, intervention should begin to target parents with health problems, especially single mothers with health problems. Existing parent-based injury prevention interventions could be modified to fit the specific needs of this population (e.g., minimized access to resources and low levels of activity). Child-level interventions targeting children whose parents have physical health conditions could be even more effective than parent-based interventions as some parental health limitations may preclude parent-level intervention. These child-level interventions may be most effectively performed at community facilities like schools and YMCAs as these types of settings enable intervention to happen with large numbers of children, at a relatively economical cost, without the interference of any parent-based barriers.

Conclusion

The current study examined the associations between child behavior, maternal health, maternal supervision and home hazard as they predict child injury. Based on the theoretical underpinnings within Barbara Morrongiello's conceptual model of injury (Morrongiello, 2005), the significant relation between parent, child, and environmental factors should be considered in future child injury research, and in the development of injury prevention interventions.

The present study shows that poor maternal health is a risk factor for child injury, as is aggressive child behavior. Parent supervision and hazardous home environments are not associated with injury risk, though aggressive behavior is associated with both. The use of these

findings will be especially important to consider when conducting research and developing interventions with “fragile family” populations as these families are especially at risk for injury. Future research should continue to examine the role of supervision and home environment in the occurrence of injury as many studies have identified these factors as being associated with the occurrence of injury (e.g., Morrongiello, Corbett, McCourt & Johnston, 2006; Rowe, Maughan & Goodman, 2004; Schwebel, Speltz, Jones & Bardina, 2002; Myer, Roelofs, Bluestone, 1963; Spiegel, Lindaman, 1977). Most existing interventions target one of these two factors. As poor maternal health was first identified as a risk factor for child injury in the present study, further research should also continue to examine the specific role that maternal health plays in the occurrence of child injury. Finally, while the results of the present study are not without limitations, the findings should be considered alongside existing child injury literature so that together this information can continue to inform work with, and research of, children and parents most at risk for injury.

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